

ANALOG

SCIENCE FICTION AND FACT

MID-DECEMBER 1993

STEPHEN L.
BURNS

Showdown
at Hell
Creek

JEFFERY D.
KOOISTRA

G. HARRY



*****5-DIGIT 94022
22RYD 21346 63F09X 28
19 APR95 AFF ED 00000
AB
HALSEY L ROYDEN
13466 3 FORKS LA
LOS ALTOS CA 94022



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Announcing
a better way to
learn how to...

Write for

IF YOU WANT TO WRITE LIKE A real professional, begin at the beginning. Start with the basic building blocks used by successful writers—no matter what their specialties may be—and once you master these basics, you can write for any market that interests you.

You've already seen enough, known enough people, experienced enough relationships and accumulated enough facts, special knowledge and wisdom to fill a five-foot shelf.

But what you may not have in equal depth is the professional training and techniques you need to get it all down on paper and put it across to the editors and publishers who decide what will appear in print.

Where does a beginner turn for help?

Most aspiring writers "go it alone"—not because they prefer to struggle in isolation, but because they don't know where to turn for help, or because the only help available is in a seminar, classroom, or lecture hall. They need personal, individual attention—not stiff competition from their classmates for the few minutes an instructor has available for questions. There *had* to be a better way to learn!

The challenge was taken up by a group of writers and editors whose inspired coaching over the last 20 years has produced hundreds of published writers. The program they developed, *Breaking into Print*® combines two basic forms of creative writing: articles and short stories. Virtually every piece of writing in the English language that you admire was created with these same basic building blocks.

Your coach works with you one-on-one

To be a good writer, you need a winning coach. If you qualify for *Breaking into Print*, your coach will be a pro—a widely published author of short stories, books and articles, or an experienced editor. His or her one-on-one coaching will help you, develop your strengths, overcome your weaknesses, and guide you through the tough spots.



If you qualify, your personal coach will be a widely published author of short stories, books and articles, or a professional editor.

You progress at your own pace, on *your* schedule. Your personal writing coach fits his or her schedule to yours and is always there, ready to work when you are.

These master writers and editors know how to teach and how to coach aspiring writers to bring their writing up to publication standards. They also know that getting published demands accurate knowledge of specific markets—as well as solid writing tailored to current editorial requirements.

We help you to find your own writing niche

For these reasons, *Breaking into Print* not only teaches you how to write articles and short stories—it also guides you to your strongest form of writing, the writing niche that's best for you.

But it doesn't end there. Your coach will stick with you after you find your niche and show you how to market your finished work to that segment of the market. You're a team: he or she is a winning coach training you to become a winning writer.

This one-on-one teaming of a beginner with a skillful mentor offers you a quality and

Publication!

A "New" Way to Learn

An important feature of any writing program designed for today's adult is flexibility—not a fixed classroom routine, but a program that fits his or her schedule.

Students must also be free to work at their own pace. Yet, their personal writing coach must always "be there" for them—responsive, constructive and supportive.

These are the hallmarks of *Breaking into Print*, a new correspondence study program offered by Long Ridge Writers Group.

Correspondence study—established at Yale and the University of Chicago over 100 years ago—is today's "new" way of learning. It's the way more than 3,000,000 busy adults are learning new skills right now!*

*Sources: U.S. Department of Education and National Home Study Council, Washington, D.C.

intensity of training in writing and in *marketing* your writing that we have not found in any school, college or university anywhere!

"It beats any college class I've taken hands down"

"Comparing it to college classes I've taken in the past, the detail of criticism is far better and more valuable to me," reports Jeffrey T. Homan, Plymouth, MA. "It beats any college class I've taken hands down."

You must qualify for the team

But first you must qualify for the team. You must demonstrate the necessary potential and the capacity to accept constructive criticism from your coach, learn from it, and turn it into a winning performance. If you have the aptitude and the maturity to qualify, and if you decide to enroll, you'll get our commitment in writing:

Your personal coach will teach you how to—

1. *Write articles and short stories, the building blocks of all good writing;*
2. *Find the writing niche that's right for you; and,*

3. *Market your writing effectively.*

By the time you finish the program, you will have written at least two manuscripts ready to send to a publisher.

The building blocks of success

America's appetite for writing is enormous. There are more than 42,000 publishers who produce two billion books, and hundreds of millions of newspapers, magazines, trade papers, specialty publications and newsletters every year. They all need writers to keep them going—staff writers or freelancers, or both. And these writers use the same building blocks you'll master in *Breaking into Print*.

Free evaluation offered

To identify men and women who are qualified for this exceptional program, we offer a writing evaluation. To receive your free copy and a program brochure, mail the coupon below today.

Our professional staff will evaluate your writing at no cost to you. If it reveals true writing potential, you will be eligible to enroll. But that's entirely your decision.

Long Ridge Writers Group,
91 Long Ridge Road
West Redding, CT 06896-0802

Yes, please send me—FREE—"Your Writing Evaluation" with an illustrated brochure describing your program.

I understand that if my evaluation reveals true writing potential, I may enroll—but I am under no obligation and no salesperson will visit me.

Mr. Mrs. Ms. Miss

(PLEASE CIRCLE ONE)

P4276

PRINT NAME CLEARLY

STREET

APT.

CITY

STATE

ZIP

Approved, Connecticut Commissioner of Education

COPYRIGHT © LRWG 1993, A DIVISION OF THE INSTITUTE, INC.

ANALOG



12



72



126

Vol. CXIII No. 15
Mid-December 1993

Next Issue on Sale
December 7, 1993

Novelettes

SHOWDOWN AT HELL CREEK, Stephen L. Burns	12
PAPER VIRUS, Joe Martino	126

Science Fact

COMES THE REVOLUTION. . . . , G. Harry Stine	50
--	----

Short Stories

R-TRNRD, Bud Sparhawk	72
ONE PICTURE IS WORTH . . . , Mike Moscoe	86
PIBLOKTOQ, Paula Robinson	102
PUFF, Jeffery D. Kooistra	116

Reader's Departments

THE EDITOR'S PAGE	4
BIOLOG, Jay Kay Klein	110
THE ALTERNATE VIEW, G. Harry Stine	111
IN TIMES TO COME	115
THE REFERENCE LIBRARY, Tom Easton	160
BRASSTACKS	168
UPCOMING EVENTS, Anthony Lewis	176

Cover by Chris Moore

Christoph Haas-Heye
President and Publisher

Stanley Schmidt
Editor

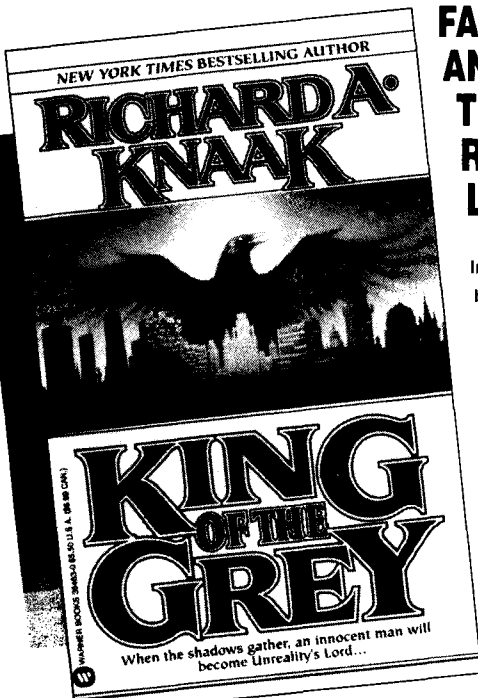
Tina Lee
Managing Editor

Terri Czezcko
Art Director

Indicia on page 5

news from

Questar



KING OF THE GREY
Richard A. Knaak
0-446-36463-0/\$5.50 (In Canada: \$6.99)

FANTASY, SUSPENSE, AND NON-STOP THRILLS COMPETE IN RICHARD A. KNAAK'S LATEST ADVENTURE!

In this exciting story, the *New York Times* bestselling author of *Dragonlance: Heroes: The Legend of Huma* and the *Dragonrealm* series combines epic fantasy and contemporary suspense in the tradition of Stephen Durst.

The Grey is imagination come into existence, responsible for those shapes people see out of the corners of their eyes that disappear in a wink. Although always mysterious, the Grey is relatively harmless unless it finds a human anchor—a King—to give it stability of form and mind. And in an unassuming Chicago commuter, the Grey has finally found what it needs. Unaware of his fate, Jeremiah Todtmann begins his daily trek to work—only to discover that the shadows of the city seem deeper, more alive, and hungry for him. Jeremiah Todtmann has become the new King of the Grey.

AVAILABLE AT BOOKSTORES EVERYWHERE

A Time Warner Company Questar is a subsidiary of Warner Books, Inc. 1993 Warner Books, Inc.

EDUCATION FOR ALL

Not long before I started writing this, in the spring of 1993, my eye was caught by a news story stating that the President of the United States had, in proposing a revamped federal student assistance program, “pledged to make college affordable for all Americans.”

The article was not detailed enough to make clear exactly what the President meant by this; and as I write, it's still too early to be sure just what, if anything, will actually come of it. But the phrase had such a lovely ring to it that the sometime educator in me latched onto it at once. I found myself thinking, “Suppose he really did say exactly what they say he said, and that he meant exactly that: we will make college affordable for all Americans.” Is that goal either achievable or desirable?

The question is so fundamental, striking so directly at the underlying philosophy of what education is for, that it warrants pondering regardless of what the federal government may

have done by the time you read this. In my pondering I chose to assume that when the alleged pledge said “college,” it meant *college*. Beyond that, the interpretation got a trifle trickier. Did it mean that the goal is to see that finances alone would not keep any *otherwise qualified* American out of college? Or did the phrase “for all Americans” mean that *any American who wanted to* should be enabled to go to college?

If the former, I had no problems with this dream, except for the question of whether the federal government should be the one to do this enabling at a time when it's supposedly trying to free itself of a huge deficit. That's a separate question that could lead me far from my main thrust today, so I'll ignore it. Let's concentrate for now on the second interpretation—one that I know some people *do* advocate—that any American who wants to should get financial aid as needed to let him or her go to college.

Is *that* an achievable and/or desirable goal?

I see three obvious problems with it. First, *there simply aren't enough colleges and universities to accommodate everybody who might like to attend one*. This isn't necessarily a problem; if the students and funding are there, existing institutions can be expanded and new ones created, at least up to a point. As a former college teacher myself, I'm very well aware that there are plenty of people who *can* teach college who have been driven into other fields by a lack of jobs in their chosen field. (No, I'm not one of them. I liked teaching a lot, but left a tenured professorship because editing *Analog* sounded like too much fun to pass up!) As a former college teacher who might someday like to return to academia, I should probably be all for anything that would expand the job market there.

There might or might not be enough potential professors to handle the demand if a scheme were implemented to make college accessible to all interested Americans. If there aren't now, more could be trained—and such a process would create many new jobs, which almost everyone considers a good thing.

There is, of course, another approach to handling large demand, and the temptation to use it seems to me a secondary part of my First Obvious Problem. I refer to large classes—which in some cases, at large universities, means *huge* classes. While I was teaching at a college with a total of 1,200 students, I was visited by a university student whose *biology class* had 1,400—and that was just Section A. (Section B didn't even have a live lecturer, but a videotape replay of Section A.) A class that big simply can't work as well as one with 20 or 30 students and a conscientious teacher.

On the other hand, it *can* work, even if not as well, and a sufficiently capable and conscientious student will still get a good education from it. (I can vouch for that because I did my own undergraduate work at a large university, though none of my classes were *that* big.) The small college with small classes was far more expensive to attend than the big university. Many students who couldn't afford the little one might be very grateful for the big one. But under federal pressure to let everybody go to college, I would be concerned about subsidiary pressures to force more students into larger classes.

Analog Science Fiction and Fact (Astounding) is published every 28 days which includes special issues in January and July by Dell Magazines, a division of Bantam Doubleday Dell Magazines, at \$2.95 a copy in the U.S.A., \$3.75 in Canada. 1 year subscription for \$39.97 in the U.S.A. and possessions; in all other countries, \$49.97 (GST included in Canada, GST # 123054108) payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address allow 6 to 8 weeks and give new address as well as the old address as it appears on the last label. Call 1-800-333-4561 with questions about your subscription. Second class postage paid at New York, N.Y., and at additional mailing office. Canadian postage paid at Windsor, Ontario, Canada Post International Publications Mail Product Sales Agreement No. 280622. © 1993 by Bantam Doubleday Dell Magazines, all rights reserved. Protection secured under the Universal Copyright Convention. Reproduction or use of editorial or pictorial content in any manner without express permission is prohibited. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental. All submissions must be accompanied by stamped self-addressed envelope, the publisher assumes no responsibility for unsolicited manuscripts or artwork.

POSTMASTER: Send change of address to ANALOG SCIENCE FICTION AND FACT
P.O. Box 5133 Harlan, IA 51593-5133.

IN CANADA RETURN TO 3255 WYANDOTTE STREET EAST, WINDSOR, ONT. CANADA N8Y 1E9
Editorial and Advertising: Analog Science Fiction and Fact, 1540 Broadway, New York NY 10036
Subscriptions: Analog Science Fiction and Fact, P.O. Box 51593-5133 ISSN 1059-2113

Printed in the U.S.A.

that everybody who wants should have a chance to *start* college, with the understanding that many of them won't be able to complete it? Or will faculties come under pressure to dilute what they're calling "college-level" so that practically everybody can get an increasingly meaningless degree?

This has already happened to some extent in some colleges and high schools—and when it happens in high schools, the consequences filter up to college. When I was teaching college, a common complaint of professors was that they were having to spend more and more time teaching “remedial” material that they should have been able to take for granted as part of the background of high school graduates. This was true even at the rela-

Published
since 1930

CHRISTOPH HAAS-HEYE
President and Publisher
Dell Magazines

FRED SABLOFF
Associate Publisher
Dell Magazines

JACK HOEFT
President and CEO
Bantam Doubleday Dell
Publishing Group, Inc.

ADVERTISING OFFICES
NEW YORK
(212) 782-8532

**ADVERTISING
REPRESENTATIVE**
Dresner Direct, Inc., N.Y.
(212) 889-1078

First issue of Astounding
January 1930 ©

Classic Sci-Fi Art 1930-1949

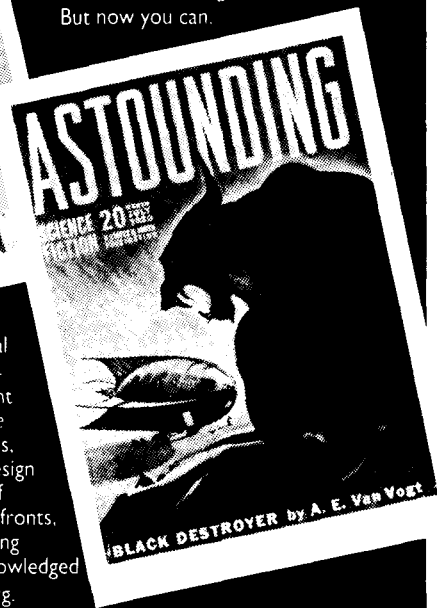
ASTOUNDING SCIENCE FICTION

Premium Collector Trading Cards



The history of science fiction art would be incomplete without the inclusion of the 1930s' and 1940s' *Astounding Science Fiction* covers. Alien races invaded Earth. Space men explored the stars. Wondrous inventions solved mankind's problems. Technology ruled the world. It was almost more than one could imagine.

But now you can.



Many of the original magazines are lost today, but you can re-discover them in their original amazement in *Astounding Science Fiction Collectible Trading Cards* from 21st Century Archives, winner of the 1992 "Non-Sport Card Design of the Year." This 55 card collection is of exceptional quality, featuring UV-coated fronts, four-color fronts and backs, and fascinating background information written by acknowledged science fiction historian Robert Weinberg.

Look for this set where cards and comics are sold or order your sets today, and you will relive the golden age of science fiction. You'll discover that the original imagination and wonder of 50 years ago has not faded with time.



Please send me ____ 55 card sets. I have enclosed \$15 plus \$3 postage & handling for each set. Please allow 4-6 weeks for delivery.

NAME _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____

Please remit check to: Taylor & Woodward Distributors / P.O. Box 20797 / Ferndale, MI 48220

tively expensive and selective school where I taught. I also saw, even there, students who were there for no good reason. They had neither the ability nor the interest to do the work; they were there solely because Ma and Pa said, "You should go to college and we're going to pay your way."

If our society, and our government, decide that Everybody Should Go to College—and come out with a degree—I see two consequences as almost inevitable. There will be far more students who are getting "educated" only because they're expected to, and practically everybody will get *less* educated. Degrees will be cheap, and worth less on the job market for at least two reasons. First, they will certify the result of less demanding and therefore less meaningful work. Second, they will have even less value than they do now for recognizing individuals who are more highly educated than others, because everybody will have one.

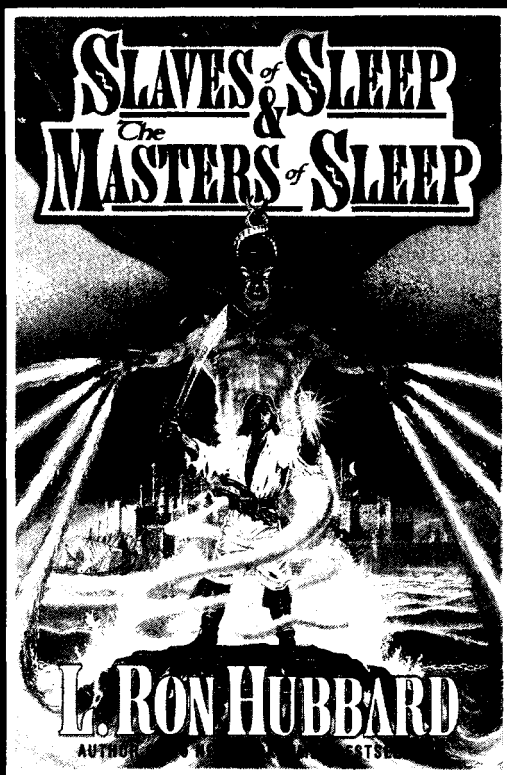
This, too, has already happened, to some extent. A bachelor's degree is now about as much of a job qualification as a high school diploma was a few decades ago. In ways, this is probably a good thing. It may actually mean that the population as a whole is better educated than it used to be (though there's plenty of evidence to the contrary). But how far can it go before it becomes counterproductive? The biggest hazard I see in trying to enable everybody to get a college degree is that it may lead to a population which is more educated on paper, but less so in reality—and therefore less able to run its country

wisely. Key point to remember: giving everybody a college degree does *not* mean you've given everybody a college education if you've made it possible by hanging the "college" label on watered-down programs that don't deserve it.

Obvious Problem Number Three is this: *there aren't enough jobs that utilize a college-level education*. Doubt it? Look around at people you've known. Chances are there are a good many who went through college hoping to find a challenging professional career and have had to settle for working in some relatively unskilled job that they find boring and frustrating. I remember once coming to New York for a physics convention and riding into Manhattan from the airport with three physicists talking physics in the back seat of a cab—with the driver joining in because he could, but didn't get much chance to talk physics in the only job he'd found.

This problem is not quite as simple as it sounds. Job training is not the only reason for a college education, and job satisfaction is neither necessary nor sufficient for *life* satisfaction. Several of the people I most like and admire went to college but made a conscious decision to avoid the "rat race" associated with many careers. They have created satisfying lives for themselves with modest incomes derived from manual labor, and the personal independence to enjoy other aspects of their lives that many "rat racers" could learn from. I don't think any of them regrets his or her college education or considers it wasted, but it has little direct application to how

From the Cutting Edge of Fantasy Comes a Gripping Tale of Swords and Sorcery



RELEASING
OCT. 18th

"Possibly Hubbard's best." – Gregory Benford
"...rousing adventure tales." – Roger Zelazny

What do a bloodied scimitar, a distraught executive, a menacing Jinn and a priceless diamond have to do with the future of Earth? Read L. Ron Hubbard's spellbinding fantasy novels, **Slaves of Sleep & The Masters of Sleep**, now published for the first time in one complete edition.

Also available as a six-hour audio program, performed by Rene Auberjonois, the shape-shifting security officer Odo in "Star Trek: Deep Space Nine."
Hardcover or audio \$19.95.

Get your copy today, wherever fine books or audio are sold.
Or order direct: Call 1-800-722-1733 (1-800-843-7389 in CA)

© 1993 BPI. All rights reserved. 2608933513

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

they make a living.

Some people can do what they do; others can't. For many, there is, for better or worse, a high correlation between career satisfaction and overall satisfaction. So if we try to make everybody college-educated, knowing that relatively few of them will find careers that directly use what they learned, we should first give some thought to this question. How many of those people will find their college education an asset anyway, through hobbies or simply what it did for their personal development, and how many will be frustrated by their inability to apply it directly to their jobs?

From the standpoint of what the government is actually likely to do, these concerns may be groundless (or they may not be). But before anyone travels too far down any proposed road, I would like to offer a modest counterproposal: *try to make college affordable for all who can take full advantage of it, but let that be competitive.*

The proposal that started this train of thought was inspired by a genuine and important problem. There are potential students who could do good, genuinely college-level work, and derive huge benefits from it that would spread to others they come in contact with, but who are not getting the opportunity for purely financial reasons. I would very much like to see programs (though not necessarily federal programs) to help more of those students get the chance to achieve their potential.

But not *all* students. Not everyone

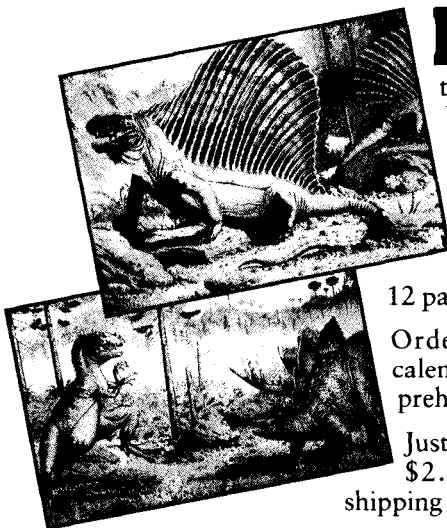
is cut out for that kind of work; not everyone would like it; not everyone would get much out of it. The effort should not be to help *everyone* get a college education, because in the end that would mean either that many would fail, or that "college" would no longer be college. The effort should be to identify those who *want* college *and* can handle it, and concentrate on maximizing *their* chance to do so.

And what about the others? What they need is not college, but a change in people's attitudes. Yes, a college education is a special thing, in some ways, and it's more so in a society where not everybody gets one than it would be in a society where everybody did. Those who have survived college have earned a certain kind of respect—but not the *only* kind of respect, and not the right to stigmatize those who haven't. A society that thinks everybody should have a college education tends to look at people who don't as somehow inferior. It ain't necessarily so. What the people "in the trenches" do is at least as vital to the operation of society as the work of those who are too often viewed as "above." In many cases, the latter couldn't do the work of the former if they had to. Personally, I have a great deal of respect for a skilled machinist, mechanic, farmer, or printer. Rather than trying to get everybody a college degree, no matter how dilute, a more productive course might be to get those only for people they fit well, and meanwhile cultivate a healthy respect for *other* kinds of knowledge and work. ■

Dell Magazines Presents A New 1994 CALENDAR...

DINOSAURS

AND OTHER PREHISTORIC REPTILES



Recreate the fearsome world of the dinosaurs through the paintings of Robert F. Walters in this 1994 calendar. Vivid images bring prehistoric habitats alive with dinosaurs fighting for survival from the snow-covered steppes to lush tropical rainforests. 12 paintings with detailed captions.

Order your exciting Dinosaur calendar today, be transported to prehistoric times tomorrow.

Just \$10.99 for each calendar plus \$2.95 Delivery Charge (.50 shipping for each additional calendar).



Sterling Specialties

P.O. Box 6105, Dept. 133 AN
Novato, CA 94948-6105

1-800-365-YEAR

Please make checks or money orders payable to
Sterling Specialties, or you can charge to
VISA or MasterCard.

YES! Send me _____

DINOSAUR Calendars at \$10.99 each.

Please include \$2.95 delivery and
8.25% Sales Tax for CA Residents.

Total enclosed \$ _____

Name _____

Address _____

City _____ State/Zip _____

Credit Card # _____ Expiration Date _____

Signature _____



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Stephen King
**SUNSHINE
DOWN
IN
THE
CREEK**

*The same event can look very
different to different viewers*

Illustration by Alan Lee



My partner and I couldn't have cut it any closer if we'd tried. When our plane finally landed in Washington DC, less than two hours remained before our session was to begin.

I'm sure we earned tenure in hell by faking out three nuns (*Hey! Look! Isn't that Whoopi Goldberg?*) for the first available cab. The cabbie kept eyeing us in the rearview mirror as if he suspected we might just be fare-jumping terrorists. We left him grid-locked and cursing several blocks from the Smithsonian, and covered the last half-mile on foot, making it with almost ten minutes to spare. I was glad I was wearing jeans and sneakers rather than a dress and good shoes. My partner made good time in spite of his House of Machismo cowboy boots.

The appointment we were trying to make was a very big deal for us, and we'd set out with every intention of going into our session as rested and relaxed as possible under the circumstances. But we'd gotten hung up for over thirty hours in a blizzard-bound Chicago, passing a restless night curled up on the floor around our briefcases like two overeducated bag-people.

Still, we'd made it, puffing and panting from our run. Wearing the clothes we'd slept in and wild-eyed with adrenaline, vending-machine coffee, and sugar and carbohydrate-rich airline snacks.

We is myself and my erstwhile partner Dr. Enrico "Reek" Gruen. A first-class mind, and not too bad a body for a man in his fifties. Under normal circumstances he tends to be

a borderline hyperkinetic with a moderate Casanova complex. The combination of tension, exhaustion, and sleep deprivation had put him in rare form.

As we trailed along behind RTV Project Director Anna Symes, a rather amazonian redhead whose tightly-skirted behind kept drawing his bloodshot eyes, he was as cranked up as someone who'd just munched down a whole bottle of No-Doz.

He kept restlessly shifting his briefcase from hand to hand, adjusting his wire-rimmed glasses, tugging at his collar, fiddling with the plastic ID badge pinned to his jacket, and raking his curly silver hair into fresh disarray. The whole time his head kept swivelling from side to side like a gawker on a carnival midway—always coming back for another moon-eyed gander at Director Symes's shapely stern.

All that would have been bearable. It was the monotonous bubbling litany of, "*Oh boy oh boy oh boy oh boy*," he kept up the whole time that was driving me nuts.

I was nervous and tired. I felt string-haired, bag-eyed and frumpish, especially compared to fashion-plate Symes. I was retaining water. I was ready to throttle him.

"Will you knock that off, Reek?" I hissed after giving him a discreet elbow in the ribs to catch his attention. "One of these guys with the guns might just decide you're a dangerous wacko."

He looked startled, sneaking a look at the armed guards nearby, and then chastened for all of thirty seconds.

The security was tight enough to make you feel either very secure or extremely paranoid. We'd already passed two checkpoints on our way to this corridor deep under the Smithsonian, and there was one more to go. But the guards watched us pass by with an air of tolerant amusement. Even though the RTV Project had only been running a couple weeks, no doubt they'd already seen quite a few people even more keyed up than we were make this pilgrimage.

Me, I get quiet when the pressure's on. My husband says I turn into a wooden Indian. I suppose I do take more after my father, a full blooded Navajo, than my mother, whose Italian ancestry has shaped her to live life like it was Grand Opera.

Still, I prefer to think of myself as a woman of wild, deep-running passion. A smouldering volcano whose banked heat is capable of melting solid granite. Of course I also like to think of myself as a perfect size four, even though it takes constant diet and exercise to keep me squeezed into a size fourteen.

Director Symes had been talking on a portable phone while she personally escorted us to the RTV room. As we covered the last hundred feet to the guarded door at the end of the corridor she switched the phone off and stuck it in the holster at her belt. Believe it or not, the holster matched her shoes.

"Sorry about that," she said, smiling back over her shoulder at us. "I had to approve a last minute session-swap."

"That's quite all right," Reek offered gallantly, picking up his pace to

walk beside her. "Running this project must be *terribly* complex." If unctuous charm could be bottled, he was exuding enough to fill a bucket.

She gave him a wry smile. "It's like running a circus."

"I can well imagine. I do hope our late arrival hasn't caused you too many problems."

She patted his arm, her coy expression and tone proving that the old Reek charm still worked—even though his rumpled clothes, stubbly cheeks, and general wild-eyed appearance made him look like someone who'd sidle up to you crabwise and try to bum a quarter toward a fresh can of Sterno. "That wasn't your fault, Dr. Gruen."

"Please," he cooed, "call me Reek."

Thank god we reached the door by then. Otherwise I might have been forced to say something crude. The two uniformed guards nodded at Symes and stepped aside, allowing her access to the electronic lock beside the door. She took out her card, but didn't put it in just yet.

"All right, this is it," she said, her tone turning brisk and businesslike. "Normally you would have had an orientation session first, and a chance to meet one of the Ri'C'ka—" She may have worn too much makeup, but she had that double glottal pop down perfectly, "—before your RTV time slot. But you didn't, so you've got to go in cold. Still, I'm sure you'll do fine. Your RTV operator is extremely experienced. She's a post ovulating female, and her name is Hoon."

She hesitated, glancing around furtively and lowering her voice. "You

may find Hoon somewhat, well, *eccentric*." The ghost of a shrug. "To be perfectly frank, they all are, and it seems the older they get the odder they get. But I assure you, Hoon is one of their best RTV operators. As for your RTV time slot itself, you've been granted—" She pulled out a notebook and began flipping through the pages.

"Twelve hours," I put in helpfully. Reek's one-track mind had hit a fork in the rails. He stood there jittering from foot to foot, his gaze traveling from the straining button of Director Symes's blouse to the door and back again, unable to decide which he wanted opened worse.

She nodded and smiled at me. "Thanks, Dr. Mumford. That's the biggest bloc the Ri'C'ka grant. They must have found your proposal quite interesting." She closed her notebook and put it away. Reek had fixated on the door, so she addressed her next comments to me directly.

"Anyway, let me warn you that realtime viewing is very seductive. Keep in mind that it might be years before you get another chance to use an RTV. The more high-speed scanning and recording you do, the more information you collect. Remember that and you'll be fine."

"We will," I told her, elbowing Reek in the ribs to get his attention. "Won't we?"

"Good. So are you ready?"

Reek grinned at her, nodding so hard it's a wonder his brains didn't rattle. "Absolutely. You bet. Raring to go. No doubt about it."

The director looked at me, an un-

spoken question in her eyes. I think she was having second thoughts about becoming the mother of his children. I couldn't blame her. It's a big step to start insanity running in your family.

"Don't worry," I told her, "I'm used to keeping him on a short leash." Reek looked hurt, but didn't argue.

"All right then." She turned toward the reader and passed her magnetically-coded card through the slot. The reader chimed in acceptance. The door slid open. "Good luck."

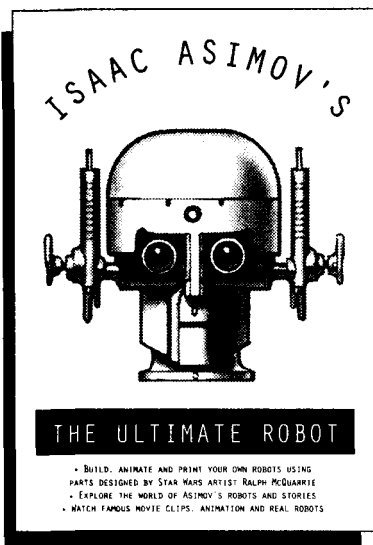
"Thanks." Reek and I exchanged a glance. He was doing his best to look calm and in control.

"Are you ready, Glin?" he asked.

I took a deep breath, let it out slowly, then nodded. Although doing my best to remain outwardly calm, I admit that I was every bit as nerved up as my partner. Maybe even more since I wasn't doing anything weird to let it out.

Our nervousness was hardly surprising. For one thing, we were about to come face to face with a being from another planet. Sure, I'd seen the Ri'C'ka on the tube, just like everybody else. The media loved them. My husband Dave and I had watched one guest-host Letterman the night before Reek and I left Montana for Washington. Just about everybody except the usual xenophobic fundamentalist lunatic fringe had accepted their existence and presence on Earth.

Still, the anticipation of coming eyeball to eyeball with your first real live space alien is bound to twang your nerves a bit.



ISAAC ASIMOV'S THE ULTIMATE ROBOT CD-ROM

- BUILD, ANIMATE AND PRINT YOUR OWN ROBOTS
- WATCH ASIMOV DISCUSS ROBOTS
- READ ASIMOV'S CLASSIC ESSAYS AND ROBOT STORIES
- WATCH ROBOT FILM CLIPS FROM 2001, FORBIDDEN PLANET AND MANY OTHERS!

A special offer for readers of Isaac Asimov's Science Fiction Magazine

The deluxe, limited edition CD-ROM package for 20% off! With a special print limited to 1,500 copies, signed by Ralph McQuarrie, designer of *Star Wars*™!

IT'S THE ULTIMATE ROBOT EXPERIENCE!

Macintosh version requires System 7.0, 4MB RAM, 12" color monitor, CD-ROM drive.

MPC version will require 386 processor, sound card, VGA monitor, Windows, Windows MM extensions.



© Ben Asen

- ☐ I want my deluxe Macintosh compatible *Ultimate Robot* for \$79.95 (list price \$99.95) plus \$4.95 s/h.
- ☐ I want information on the deluxe MPC compatible version.
- ☐ I want my Byron Preiss Multimedia demo disc for the Macintosh, featuring previews of product by Gahan Wilson, Moebius and others for \$10 plus \$2.95 s/h.

DEPT 133 AN

Mr./Mrs.
Miss/Ms. _____

Address _____ Apt. _____

City _____ State _____ Zip _____

Send your order to:
The Ultimate Robot
Byron Preiss Multimedia
Company, Inc.
24 West 25th Street
New York, NY 10010

New York State, New Jersey and Connecticut residents add applicable sales tax. Please allow 6-8 weeks delivery time.

Then there was the reason we were meeting this alien. We were on what was quite likely the threshold of the crowning moment of our careers, becoming the first two paleontologists on the planet to use Ri'C'ka Time Viewing technology to look into the mist-shrouded well of the past and actually see a living dinosaur.

When it was announced that the Ri'C'ka were working with several museums worldwide, setting up a system which would give human scientists and historians access to their Time Viewer technology, the Hell Creek Gang pulled an all nighter to get a proposal together, FedExing it in the next morning.

Half of the Gang consists of the entire faculty of the Paleontology Department of Owl Ridge State College, namely Reek and myself. The other half is my husband Dave, one of the best diggers and site managers around, and a brilliant young graduate student named Letitia Davis. The name of our gang comes from the fossil-rich site of our Hell Creek diggings.

We're a shoestring operation, and getting an early crack at the TV was roughly equivalent to raking in a cool hundred million bucks at Lotto. Yet somehow we'd come up with a winning ticket, becoming the first members of our discipline to get RTV time.

There are a lot of hypotheticals in paleontology. There has to be. It is no easy matter trying to reconstruct an entire animal—to say nothing about how it lived—from fossilized bones. Inference and supposition has to flesh

out the picture. This gossamer tissue has been shredded and rebuilt many times in our discipline's past.

We were expecting to have direct evidence shake up some of our long-held views, and then in turn shake up the views of our colleagues with what we learned.

We thought we were ready for anything.

So did Custer.

We stepped through the doorway. I'll admit that I was holding my breath. I'm pretty sure Reek was too.

The TV room itself wasn't much to look at. It could have passed for any cellar-level lab or classroom; high acoustic tile ceiling, scuffed floor, windowless walls painted an institutional green the color of refrigerator mold. The TV took up half the side of the room opposite us, the other half filled with racks of electronic equipment and technicians to tend it. We weren't given any chance to look the setup over, though. As we stepped inside our Ri'C'ka operator popped up in front of us.

We were cool. Both of us stopped dead and stared in slack-jawed, bug-eyed surprise.

As I said before, we both knew what Hoon's race looked like. I suppose they could be best described as highly ornithomorphized people or highly anthropomorphized birds. Most people find them either pretty or cute—more along the lines of a parrot than a buzzard. No doubt they would have gotten a lot cooler reception if they'd looked like Giger's aliens instead, giant cockroaches or

sentient slime molds.

Still we weren't quite prepared for the sight that greeted us.

Hoon was about my height, 5'6" (as far as I'm concerned the metric system is like pantyhose—something you use when you *have* to, but leave in the drawer whenever possible), and wore mottled brown and white cowhide chaps on her short, somewhat bowed legs. A bright red bandanna was knotted around her feathery neck. A tooled leather gunbelt rode low around her narrow hips, a portable phone in one holster, a walkie-talkie in the other. The gunbelt's ammunition loops were filled with cigars.

She stuck out both her upper and lower right hands, one toward each of us. "Howdy, pardners." Her lower left hand was thumb-hooked into her gunbelt, and she politely tipped her white ten-gallon hat with her upper left. "Folks around these parts call me Hoon."

I recovered first, grasping the hand she offered. It was human-sized, one finger narrower than my own, but with twice as many joints in each finger. The feathers at the back of it were as soft as velvet. Color TV just can't convey the sumptuous, brocade-rich colors and textures of Ri'C'ka feathers. Hoon was predominantly blue, with touches of gold, red, green, white and violet. The blue was close to indigo, and had the iridescent sheen of a grackle's throat.

"Dr. Glinda Mumford," I said, introducing myself and suppressing a strange urge to curtsy.

"*Ya te 'eh*," she replied, delivering

the Navajo greeting perfectly. "How are things in Oz, Glinda? Good?"

Before I could figure out how to answer that, Reek recovered his composure. "Dr. Enrico Gruen," he purred, taking Hoon's hand in his own. "But you can call me Reek."

"*Grazie*," she replied, bowing to kiss his hand with her amber colored beak. His eyebrows crawled up his forehead so hard it's a wonder they didn't permanently merge with his hairline. She released his hand and mine, crossing her upper arms before her breastless, feathery chest and regarding us with bright black eyes. They were more on the sides of her feathered head than ours, but not so widely spaced as a bird's.

"So, you buckaroos ready to round up some dinosaurs?" It was a little disconcerting to hear that very human voice and movie cowboy accent coming out of her beak. The voice itself could have been either a somewhat masculine woman's voice, or a very soft male's.

"I, um, believe we are," Reek answered, still flustered from having his hand kissed.

"Then let's get saddled up and ride. Walk this way." She turned away, leading us off to the right and walking with a rolling stride copied from a John Wayne movie.

Reek and I exchanged a glance, then followed.

Hoon installed us at a wide table facing the TV, assigning each of us a high-backed leather swivel chair. "You folks get comfy, now," she drawled. "I've just got to mosey over

to check on my posse a minute, then we'll be ready to rock and roll."

"All right," I said. We watched her saunter away, heading for the half-dozen technicians who would manage the banks of high-speed video recorders which would capture the data from the TV.

They greeted her like an old buddy or a favorite professor, laughing and joking as they assured her that they were in no way anywhere near ready to record our session.

"Well, Glin," Reek whispered once she was out of what he assumed was earshot. "What do you think?"

I watched Hoon giving a young black tech a low ten—eight, actually—with her lower hands while trying to goose another tech with her upper right. "Eccentric seems like a fair description."

"Any guesses why she's playing cowboy?"

Actually, I did. "I think she's trying to make us feel at home. You're nominally Italian. I'm half Italian, half Navajo. We're from Montana, and want to round up some dinosaurs." I spread my hands. "Instant spaghetti western."

"That makes sense," he said with a nod, hoisting his fancy Haliburton attache onto the table and opening it. I did the same with my own beat-up leather satchel, getting out my papers and notepads and other paraphernalia.

Hoon came back over. "OK, folks, almost showtime. But before we start, howzabout I buy us a round so we've all got whistle-wetters within easy reach?" She let out about ten bars of what sounded like one of Bach's In-

ventions played on a synthesizer and a harpsichord. "I sure as hell need one."

"Sure, some coffee would be good," Reek told her. "Black."

"Coming up." She turned toward me. "What's your poison, sister?"

Thinking about how little sleep I'd had, and the long haul ahead, I said, "The same for me, thanks."

"You're welcome. Believe it or not, coffee puts our people to sleep. Go figure, huh?" She pulled the walkie-talkie out of one holster and thumbed the call button. "Hoon to kitchen! Hoon to kitchen! Come in please!"

"*Hey darlin'!*" answered a tinny voice with a deep southern drawl. "*What y'all need? Mo' of them deep fried cuttle fish?*"

"Don't tempt me. We need two jervas like God made 'em, and a couple bottles of *too'c'ha't'ikoo* in the TV room pronto."

"*Two minutes, sugah.*"

"Thanks." Hoon holstered the walkie talkie and smiled at us, the soft tissues above her beak crinkling and the feathers at either side ruffling up. "Just to save you a herniated tongue trying to ask, *too'c'ha't'ikoo* is a sort of seed beer."

"The Ri'C'ka drink beer?" Reek asked in surprise. He plays at being a wine snob, but if the day is hot enough and the beer cold enough, he'll guzzle it with the best of us.

Hoon clacked her beak in laughter. "Do black holes suck? Is moulting a bitch?"

"Yes?" Reek said uncertainly.

"Positutely. My people worship brewers the same way you people do

movie and sports stars." She preened her iridescent breast feathers. "My youngest chick is a Highest Nest Brewer. Order of the Black Egg and everything—that's like our Nobel prize for beer making."

"You must be very proud," I told her.

She rolled her eyes. "Oy, don't get me started! We've got work to do, right?" She rubbed her lower hands together. "I'm real pumped up about what we're going to be viewing. Dinosaurs are pretty gnarly. I've seen the stiffys upstairs, and can hardly wait to see a live one."

"Neither can we," Reek said fervently, and just a wee bit impatiently.

She chuckled, sounding like a human would, except for the beak clacking. "Don't get your shorts in a knot, Doc. Just a little more foreplay and we'll get down to it."

She leaned on the table with her lower hands. "Here's the drill. Once we start viewing we keep going until the twelve hours are up. The clock beside the Viewer will tell you how much time you have left."

She pointed to a door on our left with an upper hand. "That's the powder room there, and you don't have to skip washing your hands 'cause there's a video monitor set up so you don't miss anything. You can order food and drink from that intercom between you. The big red button in front of it takes an instant photo of whatever's on the screen."

Straightening up, she pulled a cigar from an ammo loop, tore off the wrapper, bit the end off and began chewing on it like it was bubble gum.

"As for Viewing, just tell me what and when you want to see. I can lock onto individuals, groups, or specific places from any viewpoint. I'm sure Big Red told you that the more high-speed viewing we do the more data you'll bag. I can read the high-speed scans to some degree, so if there's something you want me to watch out for, just say so. *Capish?*"

We both told her we did.

"I knew you would. I guess that leaves only one thing I want to add." She leaned closer, her bright black eyes swiveling to look straight at both of us at the same time. "Like it or not, the past is what it is, if you get my drift. That means it ain't always what you expect."

There was a subtly ominous note in her voice when she said that. It was a warning. A mild one perhaps, but a warning all the same. Now I know why it was there, but right then I was completely in the dark.

"Are you trying to tell us something?" I asked uneasily.

Her upper beak wrinkled and her feathers fanned out as she smiled. "I just did." She bit off another chunk of cigar and looked around in time to see one of the techs remove a tray from what had to be a dumbwaiter. "Your joes and my suds are here. Looks like it's time to quit flapping our beaks and get some work done."

A couple minutes later Hoon had settled herself into a low, sling-chair sort of affair in front and slightly off to one side of our table, a tall spiral-glass bottle of clear golden seed beer beside her. On her lap was the

Viewer's controller, a flat, glossy black device about half again the size of a computer keyboard, its entire face covered with tiny glowing red dots. Beyond her the tape-jocks stood by their racks of equipment, ready to record the TV's output.

Reek and I each had a Thermos carafe of coffee, our notes, and our hearts in our mouths. The TV was directly in front of us, about twelve feet away, a twelve foot wide, eight foot high slab of a material that looked like polished obsidian. Although it appeared to be only a couple inches thick, it was freestanding. Looking at it you somehow got the feeling that it would take a bulldozer to knock it over.

"Lights!" Hoon called. They dimmed down to a comfortable level, still bright enough to let us read our notes and see Hoon.

"The location you asked for is the Hell Creek area of Montana," Hoon continued, the fingers of all four hands flickering across the controller board at a rate that would make a ragtime pianist look like a hunt and peck typist. Red lights turned to orange, white or blue. "So let's set the Way Back Machine for exactly 70 million years ago. . . ."

"*Peabody's Improbable History*," I muttered, my gaze glued expectantly to that black slab. "I wonder which one of us is Sherman."

"Who?" Reek asked.

"Mr. Peabody and his Boy Sherman from The Rocky and Bullwinkle Show." Dave and I have every episode on tape. Since I hadn't had time to change clothes I was sitting there

wearing a faded, threadbare sweat-shirt from Whatsamatta U.

He frowned at me. "What the hell are you talking about?"

I waved him off. Some people have no grasp of culture. "Forget it."

"Just a few moments to lock on," Hoon called brightly. "Roll the tapes, kiddies." The modified video recorders would whiz through a fine-grain T-120 VHS tape in about fifteen minutes, thirty seconds of overlap at either end, four copies being recorded at all times. One for us, one for the Smithsonian archives, one for the Ri'C'ka, and one for backup. I leaned forward, holding my breath. My palms were sweaty. A Jane Fonda Workout tape couldn't have made my heart thump any faster.

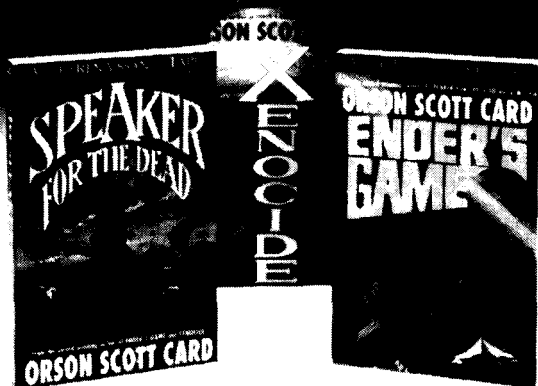
I don't know if I can explain just how sharp my anticipation was at that moment, but I'll give it a try. You have to understand that almost my whole life has been devoted to dinosaurs. My love affair—obsession, really—began when I was six. My father was a high-school science teacher. Promising me a surprise for my sixth birthday, he loaded my mother and me into our old DeSoto and drove us over 200 miles to Albuquerque.

When we got to the city and I found out we were going to a *museum* I felt betrayed. I'd been sure he was taking me to the circus. I whined and complained as dad dragged me inside. Mom trailed behind us in case I made a break for it.

I wanted to see *elephants*, and kept telling him so with a six year old's single-minded insistence.

Dad was patient. He kept telling me

The Ender Wiggin Saga On Audio!



The Nebula and Hugo Award-Winning Series From Orson Scott Card

"As a maker of visions and a creator of heroes whose prime directive is compassion, Card is not to be outdone." —*Library Journal*

Listen to Mark Rolston (*Aliens*) brilliantly narrate the millennia-spanning saga of Ender Wiggin — nine hours of some of the most imaginative, moving and intricate science fiction ever written!

**Buy the entire Ender Wiggin Saga, a full 9 hours on
6 cassettes, for only \$31.90 — and save 33%**

(Also available separately)

Qty.	Title	Price	Ext.	
—	THE ENDER WIGGIN SAGA	\$31.90	_____	
—	Ender's Game	\$15.95	_____	
—	Speaker For The Dead	\$15.95	_____	
—	Xenocide	\$15.95	_____	
	Subtotal		_____	
	Sales tax: CA residents add 8.25%		_____	
	NC residents add 6%		_____	
	Shipping and handling:	\$3.00	_____	
	TOTAL		_____	

Please mail your order with a check for the total amount to:
Audio Renaissance Tapes 133 AN
 5858 Wilshire Boulevard, Suite 205
 Los Angeles, CA 90036

Name _____

Address _____

City _____

State _____ ZIP _____

we were going to see something better. I wasn't buying it. You could have used my lower lip for a bookshelf.

Then we entered this cool, high-ceilinged hall and my life was forever changed. There before me was this massive tower of bones so big that it made an elephant look like a Shetland pony, many of its bones bigger than I was. I took one look, my eyes popping out of my head. Seconds later, there I was with my spanky-panted fanny flat on the cold marble, literally floored by the understanding that this was the skeleton of something that had actually lived and breathed and trod the Earth with its clawed feet.

From that moment on at least half of the thoughts that went through my head had something to do with dinosaurs. By age eight I may still have been a bit hazy on the critical differences between boys and girls, but I knew the difference between *Ornithomischian* ("bird-hipped") and *Saurischian* ("lizard-hipped") dinosaurs. Those times I played with girls my age their Barbie dolls got eaten.

Most paleontologists are equally obsessive. Once the imagination is ignited the rest of the mind burns.

Little by little we've gotten a clearer picture of these deposed rulers of the planet. We've gotten better at locating and dating their bones, extracting them intact, matching their fragments together to make a coherent whole, and extrapolating what kind of lives they led.

But there is a limit to what you can tell about something from its bones alone. Neither myself nor Reek nor any of our learned colleagues knew

for certain *exactly* what they looked like. We couldn't even tell you for sure what color they were, because for all our honing our conjectures to finer and finer points, none of us had ever seen one in the flesh.

The mystery was about to end as the obscuring curtain of sixty-six or more million years was pulled aside. At last we would see the enigma en-fleshed, and in doing so hopefully our understanding of these creatures would take a quantum leap forward.

"Coming up now, folks," Hoon called, sounding excited herself. "It's showtime."

A smear of light appeared in the center of the Viewer's screen, spreading quickly outward, soon covering it completely. A second later it suddenly resolved into a picture of such startling clarity that it took my breath away.

We were looking at a thicket of green, the image so sharply focused that we could see the veins on each rounded leaf and count the legs on the insects crawling over them.

"Primitive ginkgo form," Reek said breathlessly beside me. "Looks like a cycad just beyond it."

"Uh, huh," I agreed with a dry mouth. "Look at the shadows, Reek. The Sun's almost directly overhead."

"Welcome to high noon at Hell Creek," Hoon called, "Seventy million years ago."

"Now where are all the dino—" Reek began, his question turning into a gasp as it was answered before he could finish getting it out.

A blunt, boxy head dipped down out of the upper left-hand side of the

frame. It opened a mouth as big or bigger than a bathtub, and edged with fist-sized, spoon-shaped teeth. When it chomped into the thicket half of the foliage disappeared inside that maw. The dino closed its mouth and lifted its head, pulling out half the bush, roots and all.

"Hey, let's get a good look at this puppy!" Hoon chirped excitedly. Her hands flew across the controller. The view zoomed smoothly back and panned to the left.

There, on the screen, in all its glory was a living, breathing, eating—and its hindquarters came into view just in time to show this—excreting dinosaur. It stood there on a wide sun-washed marshy plain on four tree-trunk legs, clawed feet sunk into the soft ground by its immense weight. It lifted its head to swallow without chewing, then its sinuous, muscular neck arched out to full length for another bite of the ginkgo thicket, its massive tail sticking out like a prissy tea-drinker's little finger for counter-balance.

"Gawd, she's beautiful," Reek sighed in the voice of a man head over heels in love.

I nodded, and had to swallow hard before I could speak. "No more dull, dishwater-gray dinos, Reek." This beauty was covered with swirling bands of brick red and glossy black, broken up by streaks of vibrant coral, the red darkening to white-mottled cordovan at its underbelly.

"I know. Look how smooth her hide is!"

"Maybe she uses an antediluvian analogue of Oil of Olay?" Hoon sug-

gested helpfully.

A semi-hysterical laugh escaped me, and not just because of Hoon's joke.

I knew dinosaurs had really lived, I knew it better than most. I had seen this scene in my mind a million times. But this was no daydream, no computer animation, no Gila Monster in a B-movie dino-suit, no Harryhausen claymation; this was the *Real Thing*, and seeing it verged on a religious experience. I wanted to laugh, I wanted to cry, I wanted to find some pinhead flat-earth "Creation Scientist" who insists that the world is only a few thousand years old and fossils just a little practical joke by God, and *moon* the sonofabitch.

Instead I swallowed hard and asked, "How big is it, Hoon? Is there any way to scale it?"

"Sure is." Scalar lines appeared along the bottom and left side of the picture. "Each one of those blue marks is about thirteen inches, the reds mark six of the blues. So our little friend's about forty-nine feet from nose to tail-tip."

"Thanks." I contemplated the creature, trying to compare its size to ordinary things. It would have to crawl on its belly to go under a highway overpass. I could walk between its front legs without ducking, and yet it wasn't even all that large for its genus. As for measuring up to the really big boys, like the fifty plus foot tall *Ultrasaurus*, or the one hundred forty plus foot long *Seismosaurus*, this was, as Hoon called it, a *puppy*.

Reek nudged me in the ribs. "Look at its proportions, Glin. What do you

think?"

"Camarasaurid?" I asked quietly. The heavy neck and tail weren't disproportionately long, the skull was short and high, spoon-shaped teeth at the front of its low-slung jaw, its body sloping down from its tall front shoulders.

He nodded fervently. "That's my guess. So much for them being extinct in these parts by the Late Cretaceous."

Almost as if it had heard us talking about it, the dino swung its head in our direction and seemed to stare at us disinterestedly, blinking slowly.

"Green eyes!" Reek laughed. "Baby's got green eyes!"

It was then that it dawned on me that I could hear as well as see it. Green-eyes blew air through the nostrils atop its boxy head with a flatulent sound. Afterward we could hear the subterranean rumble of its gut working, the buzz and whine of insects. A sharp cry in the distance drew Green-Eyes's attention for a moment, then it went back to eating.

I don't know how long we sat there, raptly watching our dino go about its day to day business. Both of us were completely absorbed, and might well have spent our whole session like that if Hoon hadn't intervened.

"Yoo hoo! Reek! Glinda!" she called, snapping the fingers of all four hands. "You've only got twelve hours, and our playmate here will probably spend all of it at the salad bar."

We shook ourselves out of the spell that had fallen over us. Like all Americans, we could become vidiots at the

drop of a hat, and this dinosaurian *Days Of Our Lives*, while dull, had us hooked.

"Sorry," Reek said, grinning and shaking his head, "This is just so amazing."

That was an understatement. I tore my gaze away and poured us each a cup of coffee with shaking hands. He stared at her longingly. "Still, I think we owe this beauty something. What do you think, Glin?"

"Absolutely." I turned toward Hoon. "Can you follow the rest of her life at high speed?"

"Your wish is my command."

"How long would it take?" Reek asked.

"Just a few minutes. Less if she croaks or gets croaked in the next couple years."

Reek and I exchanged a glance. He nodded.

"Go for it," I said.

Hoon chuckled. "Consider me gone."

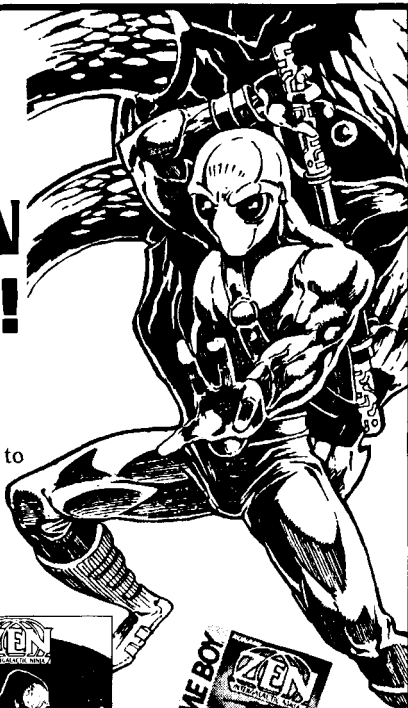
That was the beginning of the busiest, and ultimately the strangest twelve hours of my whole life.

Reek and I had planned to first gather all the broad-based data we could: true shape and coloration of as many species as we could; socialization habits—including herding, mating, and the rearing of young; diet and feeding habits in general; filling in as many of the myriad blanks in our understanding of these creatures as time allowed.

Not that there weren't plenty of questions which would remain unanswered at the end of our session. We

MEET THE HOTTEST NEW ALIEN ON EARTH!

Thrill to the full-color, graphic sci-fi exploits of Zen Intergalactic Ninja, as he battles to save planet Earth! The Official Zen Sourcebook has everything you need to know about Zen, including creator interviews and art by top talents like Sam Kieth and Mike Mignola. You can also order Zen NES and Game Boy videogames that bring all of the action to life! Get into Zen Today!



TM and © 1993 Zen Comics, Inc. (ZenCom) licensed by Sage Publications.

A SPECIAL OFFER FOR OUR READERS!

Send my 6-issue subscription to Zen (including collectible #0 issue with CHROMIUM™ cover by Jae Lee) and Zen Sourcebook.

\$ 26.95

BONUS OFFER!

Also Send _____ Konami Game Boy game(s) @ \$25.00 ea. _____

_____ Konami 8-bit NES game(s) @ \$40.00 ea. _____

NAME _____

Postage and

ADDRESS _____

Handling

\$ 3.00

CITY _____ STATE _____ ZIP _____

TOTAL

\$ _____

Send check or m.o. in US funds for total amount to: Zen Comics, Dept. 133 AN
218 Rockaway Turnpike, Suite 730, Cedarhurst, NY 11516.

had agreed to restrict our data gathering to the Late Cretaceous, the twilight years of the dinosaurs' reign. So such questions as how the thunder lizards had evolved, and why different genera seemed to have ruled different periods would remain unbroken ground for some other paleontologist to investigate. There were two reasons for confining ourselves to just one fraction of this one period.

First, you have to understand the mind-boggling amount of time even this one small slice of prehistory contained. Using extremely round figures, the Cretaceous lasted about 80 million years, starting about 145 million years ago and ending about 65 million years ago. Surveying the mere (!) 20 million years of the last quarter of Late Cretaceous in twelve hours would at best give us an hour to cover each 1,666,666 year bloc (that's roughly the time span between *Homo habilis* and *Homo health-club*), one whole minute to survey a measly 27,775 years at the leisurely pace of over four and a half centuries per second.

So even limiting ourselves to this one small (!) chunk of time meant we were taking a whirlwind tour. Europe on a coffee break.

Secondly, there was one specific question we hoped to answer. That was: *What really happened to the dinosaurs?*

Over the last few years many of us have become more and more convinced that at the end of the Cretaceous an absolutely humungous asteroid broke up in the upper

atmosphere and came down, shotgunning our planet with numerous land and water strikes. Tremendous environmental changes wrought by this cataclysmic Event sealed the larger dinosaurs' fate. If time permitted, we hoped to take a confirming snapshot or two of this earth-shaking disaster.

Some paleontologists, Reek and I among them, have thought the fossil evidence suggests a gradual decline in their populations *before* this Event.

Was there a decline? And if so, why? Over what span? Was it due to climatic change? Proto-mammals getting too clever at egg-eating? Disease? The carnivorous dinosaurs becoming too efficient for their own good? Acid rain caused by volcanoes destroying the biota or weakening egg structure? There were a number of theories. We hoped to *confirm* the decline if it did happen, and pin down the reason or reasons behind it.

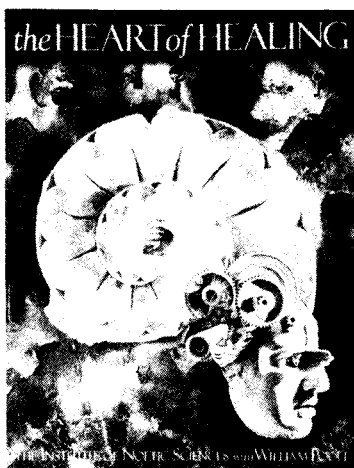
Paleontology takes a combination of patience, passion, and perseverance. Reek and I had spent the last fifteen years chipping away at this one question. We knew all the theories, and had even put forward one or two of our own.

We'd looked at this question every way we knew how, and thought we had all the theoretical bases covered.

Were we ever in for a big surprise.

Three carafes of coffee apiece and some half-eaten sandwiches later, the big digital clock to the left of the Time Viewer said that we had five minutes left in our session.

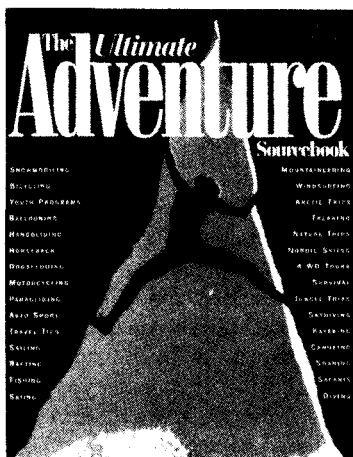
Reek and I hadn't exactly been at



WONDERFUL GIFTS FOR THE HOLIDAYS!

THE HEART OF HEALING

From the beginning of time, man's preoccupation with healing the body has been an almost religious pursuit. *The Heart of Healing*, by The Noetic Sciences Institute with William Poole, is an amazing documentation of the mind connection in the healing of the human body. See how fascinating reports of unconventional methods of treatment are repeatedly challenging some of our most deeply held beliefs about traditional medicine. This hardcover edition, with over 150 photographs in addition to illustrations and graphics, has 225 pages that focus on people across the world and explore how belief systems are at the heart of healing.



THE ULTIMATE ADVENTURE SOURCEBOOK

Looking for exotic destinations? Daring adventures? Unique excursions? Here is the most action-packed vacation guide for adventurers and travelers alike. This unique reference book covers everything from motorcycling and sailing to skydiving and safaris. The softcover volume includes detailed descriptions of both domestic and international adventures with prices and itineraries. With 432 information-packed pages and over 400 full-color photographs, *The Ultimate Adventure Sourcebook* is the complete resource for adventure, sports and travel.

Please send me: _____ copies of *The Heart of Healing* @ **\$24.95** each.

_____ copies of *The Ultimate Adventure Sourcebook* @ **\$29.95** each.

Please add \$2.00 per book for shipping & handling. NYS residents add 8.25% sales tax.

Please make check or money order payable to **Turner Publishing, Inc.**

Send to: **Turner Publishing, Inc., 420 Fifth Avenue, New York, NY 10018**

Name _____

Address _____

Phone _____

City _____

State _____

Zip _____

our best when the session started, and by this time we were completely wiped out. We had crossed and re-crossed our chosen period, leaping centuries, millennia, and even millions of years at a single bound; sampling across an area comprising Montana, North Dakota, Wyoming, Nevada, Utah, and southern Alberta and Saskatchewan, but gathering at least half of our data from the area around our Hell Creek diggings.

Like with time-lapse photography, the slower we scanned the more completely a segment of time was documented. The maximum rate the high-speed VCRs that were being used to record the TV's output could handle, came to about fifty years per minute at one frame per day.

When the TV was scanning at this speed all Reek or I saw was an eye-strain-provoking blur. Hoon was able to abstract and absorb a lot more from it than we were. Some of that was due to innate differences between her senses and ours. Some of it came from practice. Operating the TV and extracting maximum information from it was her race's passion and her profession, while our race is still struggling to master cable television and Game Boys.

So there we were, physically, mentally and emotionally totalled. We'd made hundreds of split-second decisions in the preceding hours: where and when and how long to stop; where and when to go next; how fast to scan; what to record and what to skip.

It goes against the human grain to say, *Hell, what say we skip ahead a*

half-million years? I doubt anything interesting is going to happen. Yet we had to do that dozens of times.

Hoon was of immense help. She sat there drinking beer, munching cigars, and cracking jokes, playing that TV like a pinball machine, racking up point after point for us. But ultimately the decisions were ours. Both of us had bad cases of information overload, soggy-brained from frantically dipping spoonful after spoonful from the raging Niagara flooding before us.

We had nailed down the date of the Event (late afternoon, late fall, 64,865,379 years ago) and spent our final hour concentrating on the last fifty thousand years before it happened, closing in on it, hoping we were getting enough data to conclusively prove or disprove population decline at least in our corner of the world.

Hoon had dragged us back into realtime viewing for a moment so we could get our bearings. The TV's eye-twisting blur resolved into an image of startling clarity and such completely unexpected content that Reek and I both froze with our mouths open, staring in utter bug-eyed incomprehension.

"What the—" Reek gasped, echoing my thought with the expletives deleted.

Hoon made a sound that I couldn't even begin to reproduce; it sounded like a name and a curse all at once, and it wasn't until later that I realized there had been a faint note of satisfaction in her voice.

The Thing on the screen was black and gold, and it was *big*. That was my

first impression. The bright sunlight struck off the gold parts, dazzling the eye. It stood erect on two oddly-jointed, wide-spaced legs almost thirty feet tall, the legs separated by a thick, horizontal, intricately knurled column. What had to be its body was underslung from this axis, somehow organic looking even though it was all burnished gold metal and rubbery black. A dozen arm-like appendages and maybe sense organs extruded from it asymmetrically.

Facing this Thing was a medium-sized allosaur—the Subaru version of old T. Rex—all reared up on its massive hind legs. The allosaur's smaller, sharp-clawed forefeet pawed furiously, talons like bayonets slashing the air. Opening its mouth and displaying dozens of daggerlike teeth, it let out a harsh bellow of warning and challenge that sent a chill up my spine. *Back off, buster, or you'll be sorry!*

The Thing took a mincing step toward it, multi-jointed legs working smoothly and keeping the body a constant distance above the ground. The allosaur let out an even more bloodcurdling cry than before; the sound of unadulterated rage. Then it sprang, clawed lower feet tearing huge divots out of the spongy ground.

The Thing reacted instantly, pointing a tubelike manipulator at the place where the allosaur's muscular neck met its head.

The place the Thing was pointing at simply exploded. The sound was as indescribable as it was awful. The allosaur's head vanished from sight inside a sudden red cloud of vapor-

ized blood and meat, its bellow chopped off instantly.

The allosaur's head hit the ground with a meaty thud moments later, its eyes rolling crazily and blood foaming out between its still-snapping teeth. Its headless body stood upright for several seconds longer, swaying in widening circles as blood gushed from the ragged stump of its neck, forearms pawing the air and tail lashing madly.

Finally the body toppled over sideways and crashed to the ground, hind legs kicking and forearms twitching spastically as its primitive nervous system slowly caught up with the fact of its death.

The Thing stood there impassively the whole time, apparently watching its victim's death throes. The gush of blood became a dribble. The allosaur's limbs went slack and still. Its eyes glazed over.

At that moment I saw something, realized something, and remembering something else. I shook off my uncomprehending shock, reaching out blindly to slap the red stud between Reek and myself to take an instant photo of the Thing, then stole a quick look at the clock. We had under four minutes TV time remaining.

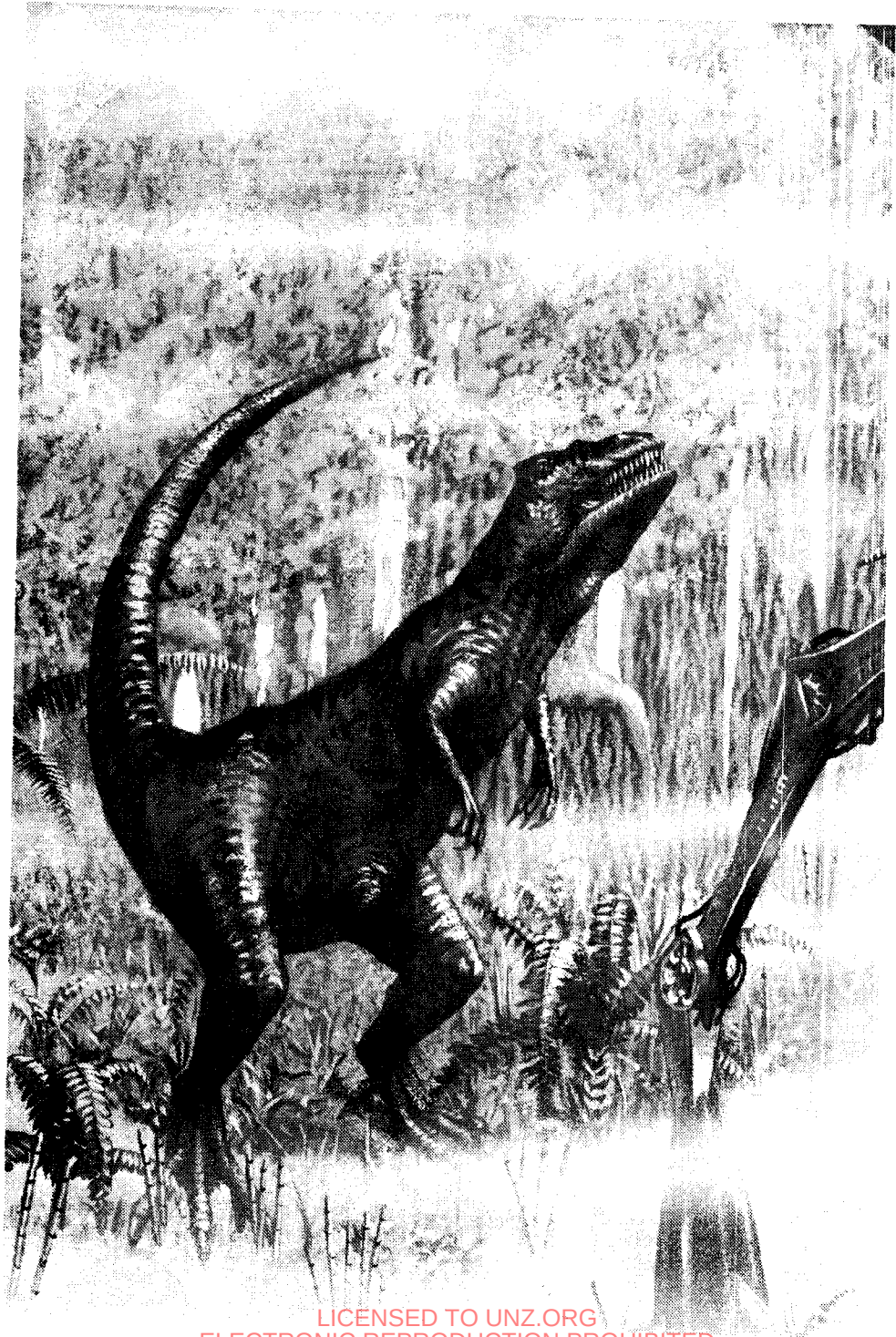
I found my voice. "*Hoon!* Can you lock onto that—that—whatever the hell it is?"

"Sure can!" she replied instantly.

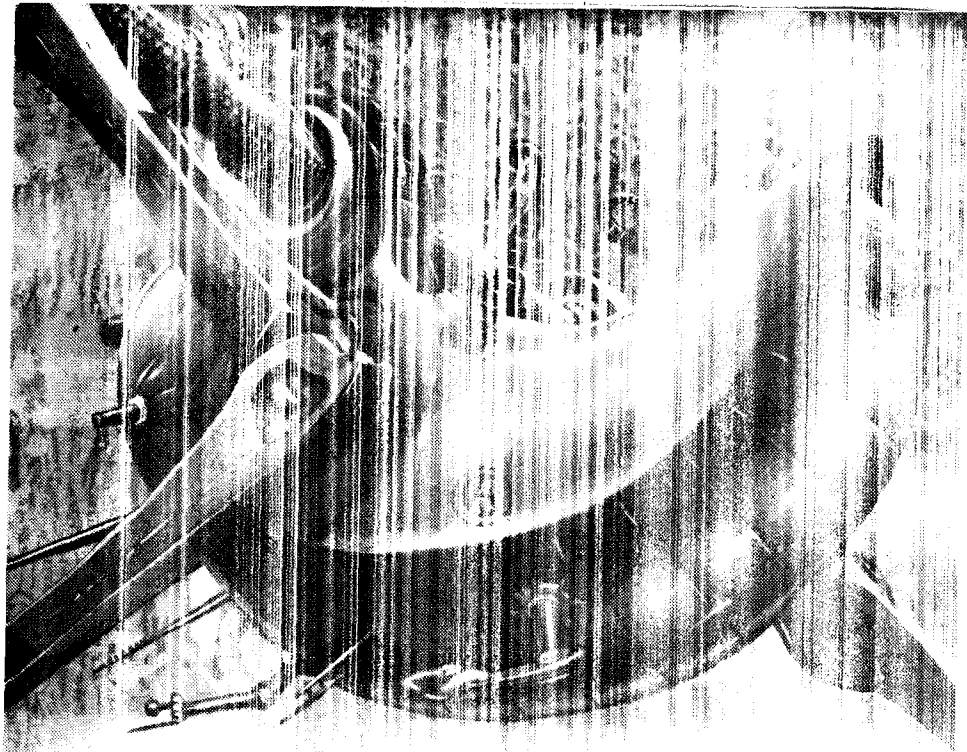
I glanced at Reek. "We don't have much time left."

He caught on instantly. "Do it, Hoon! Scan at the speed you think best!"

"Done!" Her hands swept across



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED



the board like four break-dancing spiders. The image on the TV blurred as the alien device locked onto the Thing and pursued it through the past faster than our eyes could follow. A glance at the techs showed me that the tapes were still rolling.

I checked the clock again. A hundred and forty seconds left. With a whirr the Polaroid photo of the Thing I'd taken extruded from a slot behind the button.

I didn't need to look at it. The afterimage was burned into my mind, one detail in particular standing out from all the others.

There had been *shadows* appearing under the Thing's massive feet. It had been levitating, and perhaps preparing to fly away.

Even though there was nothing

here for us to really see, both Reck and I kept our eyes glued to that big black slab, as if our attention could help it focus on our inexplicable quarry. The final seconds ticked away, both of us holding our breaths.

When the TV went dark we continued to numbly stare at it, both still groping to understand what we had just seen. I know my mind was as blank as the screen.

"Lights," Hoon called. "Tapes stop." The techs shut the machines down, and the light came slowly up to a normal level.

"Huh," Reck said at last, sounding like he'd been punched in the gut. "That was..." He shrugged helplessly, looking at me as if I might have words for what we'd just seen.

"It sure as hell was," I agreed. We

watched Hoon stand up and stretch, all four shoulders popping. When she turned toward us, I asked the question uppermost in both of our minds.

"What the hell was that, Hoon?"

She picked up her bottle of seed beer and drained it before answering. It was hard to read her face, but her posture suggested a thoughtful caution.

"That was a—" She repeated the sound she had made before, a polyphonic series of clicks, whistles, pops, squawks, and the sort of sound a computer makes over an acoustic coupler. Then she laughed. "Some mouthful, huh? Anyway, that's what we think they called themselves." She cocked her head. "The English equivalent of our name for them would be *Opportunistic Bastards*."

"What the hell was it *doing* there?" Reek demanded, sounding aggrieved. I couldn't blame him. I felt the same way. Whatever it was, it didn't belong there. *Then*.

"Just what you saw it doing," Hoon answered mildly.

Reek stared at her, his mouth working, but nothing coherent coming out. Hoon came closer, leaning on our table with her lower arms, and patting his hand with her upper right.

"I know you're freaked by what you just saw," she said soothingly. "But I really can't tell you much about it."

"You have a name for it," I pointed out, trying not to sound accusing. "You must know what it is."

"I'm not saying I don't. I'm saying I can't tell you."

"Why not?" I asked stiffly.

Hoon sighed and rubbed her beak. I had to wonder if she was as tired as we were. When she spoke it was quietly, carefully, and with an unmistakable note of apology.

"Making contact with alien races like yours is tricky stuff. A million possible pitfalls per mile. I know we Ri'C'ka sometimes seem a bit, well, *goofy* to your people, but believe it or not, we all follow a pretty strict set of rules to keep us from botching things up. You see, in our culture mistakes live forever, thanks to the TV. When we talk about 'a day that will live in infamy' we're not kidding. We want to nurture your growth, not negate it, so we tread carefully. '*When in doubt, don't*,'—that's our motto."

"If that's the case," I said, "why make contact at all?"

Hoon clacked her beak in laughter. "Why does the Ri'C'ka cross the road? To get to the other side, of course! But seriously folks, we feel it's our duty. You see, before we stumbled across Time Viewing technology our race was the proverbial basket case. We had all the usual societal ills. Wars, kakistocracy—that's government by its worst citizens, wage slavery, virulent nationalism, arms races, ecosuicide, repressive half-baked religions, the whole apocalyptic *enchilada*."

She shook her head and chuckled. "We were a mess. If it was wrong-headed and short-sighted, you can bet we'd institutionalized it, called it Civilization, and held parades to honor our wisdom and righteousness. We probably would've blowed ourselves up real good if we hadn't stum-

bled across Time Viewing technology.”

She swept one hand toward the screen behind her. “This baby is a portable but high-powered research grade TV. Small crude ones with a 200-300 year range could be built by any basement tinkerer—and they were. First by the hundreds, then by the thousands, then by the millions. A Time Viewing Underground sprang up almost overnight, and suddenly every mistake we had ever made, every wrong turn we had taken, every lie we had ever told or been told was there for all to see. Time Viewers were a window onto Truth, and the Truth will, as they say, set you free.”

“No relying on garbled Nixon tapes,” Reek muttered. “No more secret wars or hidden agendas.”

“You got it. Now everything didn’t become all sweetness and light overnight like a Utopia delivered by Federal Express. Time Viewing was like a stick jammed into the whirling spokes of the careening bicycle of politics. Of course not everybody wanted the revolution it sparked. A lot of people have a vested interest in falsehood. The ones with the most to lose tried the hardest to suppress it. Fortunately it was a self-liberating technology. Not only is every TV capable of showing precisely how it was built, it also gave its proponents the wherewithal to block the moves of those who wanted to suppress it.”

She grinned at us. “The TV was like a sudden light in our darkness. We could see ourselves for the nitwits we were, basing our lives on self-delusion and lies, and we could study the

pinheads and politics which got us there. TV saved us from self-destruction. Once we got the knack of faster-than-light travel, we decided we had a duty to share the light.”

“So here you are,” Reek said. “That still doesn’t explain why you won’t tell us what that thing was.”

“Call it scruples. Your history is yours to study and interpret. The TV may be our mirror, but it’s your face in it. We’re not Intergalactic Mr. Know It Alls, nor do we want to be—such an attitude is presumptuous, unhealthy, and dangerous. Besides, wouldn’t you agree that learning something on your own is better than being told it? That the search to understand and explain something can take you places a pat answer never can?”

“I suppose,” Reek admitted grudgingly. I nodded. Like it or not, we were hearing something we both were always telling our students; that our job wasn’t to give them answers, but to help them learn how to go about finding them for themselves.

Hoon chuckled him under his stubbly chin. “That’s the spirit, bunky! Now the presence of one of the Bastards does change the rules a bit. Take your tapes. Study the living hell out of them. Try to figure the puzzle out for yourselves. Once you think you have, call me. Then I’ll be free to confirm your findings, or maybe point out where you got off the track.”

“Call you?” I asked. “How?”

She patted the phone in her holster. “Just let your fingers do the walking. My number is 1-800-000-HOON.”

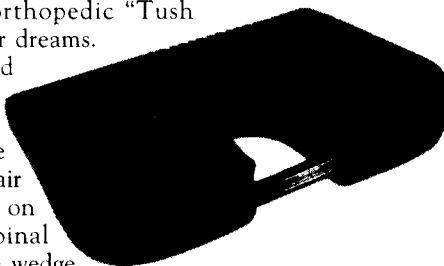
MAIL ORDER MALL

TUSH CUSH

Are you one of the millions of Americans who suffer from low back pain? Do hours of prolonged sitting leave you aching or numb? If so, the revolutionary orthopedic "Tush Cush" is the seat of your dreams.

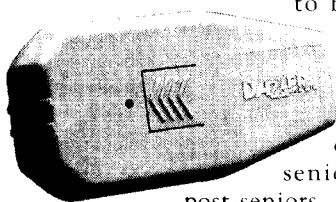
This scientifically designed seat works to relieve and prevent back pain in 2 ways: first, it suspends the tail bone (coccyx) in the air and reduces the pressure on and within the lower spinal discs; second, the unique wedge

shape tips the pelvis forward to help restore the spine's natural lumbar curve. Constructed of highly resilient polyurethane foam, the "Tush Cush" comes with a removable, machine washable, dark brown cover. It measures 14"x18" and features a handle for easy toting. Perfect for home, office, auto, sporting events, theaters, wheel chairs-or anywhere your "tush" needs a "cush"ion! **\$39.98 (\$5.75) #A1967**



HELPFUL TO HUMANS HARMLESS TO DOGS

Even the most dedicated canine aficionado can sometimes encounter unfriendly dogs. Dazer provides a humane way to repel their advance, emitting ultrasonic sound waves inaudible to humans and totally safe for dogs



(unlike mace and other common deterrents). Pocket size (4 3/4" long) plastic case can also clip on belt, takes 1-9V battery, included. For joggers, hikers, bikers, seniors and kids-plus the pro-verbial post-seniors. **\$29.98 (\$3.75) #A1829X**

TO ORDER . . .

by mail send check or credit card number and expiration date to:

CALL TOLL FREE 24 HOURS A DAY 1-800-722-9999

MASTERCARD/VISA AMERICAN EXPRESS

30 DAY MONEY BACK GUARANTEE*For Exchange or Refund

For each item add shipping and handling charge shown ()

to arrive at total price. NJ residents add 7% sales tax.

MAIL ORDER MALL,

Dept. 133 AN

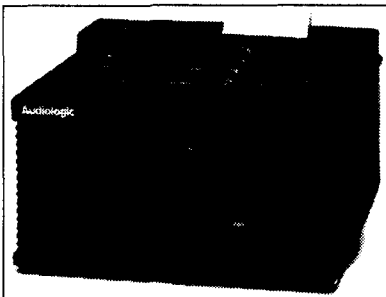
PO Box 3006,

Lakewood, NJ

08701

SLEEP SOUNDLY WITH SOUND SLEEPER

Is noise pollution interfering with your ability to get a good night's sleep? If so, then the Sound Sleeper by Audio Logic is the clock radio of your dreams. Sound Sleeper combines a state of the art AM/FM cassette clock radio with the benefits of natural sound conditioning. Sound Sleeper lets you fall asleep to the Sounds of ocean surf, rushing waterfalls and/or rainfall with the flip of a switch. After a relaxing night's sleep, wake up with a buzzer or music from the radio or cassette. So why have an ordinary clock radio when you can have the cassette clock radio that not only wakes you up but also lulls you to sleep! \$89.98 (\$6.95) #A2000



GOURMET POPCORN POPPER

The incredible Theater II through-the handle, bottom-stirring popcorn popper uses stovetop power to reach the same temperature (465°F) as commercial poppers. Popcorn explodes to full expansion, steam damage is eliminated, a faster finish preserves tenderness, and nearly 100% of the popcorn pops! Result: six quarts of the best popcorn you've ever tasted..in just three minutes start to finish. Faster than most microwaves, Wooden handle for a safe grip, and pops with a minimum amount of oil or butter for delicious diet popcorn. (approximately 500 calories per 6 quart). Produces tender, fluffy, old-fashioned movie theater popcorn in just minutes. Made in USA \$27.98 (\$5.75) #A1963



"You have a toll free number?" Reek asked.

"Sure do. And can you believe it, my kids *still* don't call!" She straightened up, adjusting her cowboy hat to a jaunty angle. "The party's over, it's time to go. It's Miller Time for me, and there's a Viking hunting expedition scheduled next. Don't want to Leif them short of time."

She headed for a door at the right side of the room, past the TV. "Besides, if I don't hit the little aliens' room shortly I'm going to end up in the doghouse for making a poodle."

Opening the door she glanced back at us, feathers ruffling in a smile. "By the way, thanks for sharing your time, folks. *Ciao*." She disappeared through the door.

"Your tapes are ready," One of the techs called. "We're sending them up to reception."

"Thanks," I told her. She and the other techs left by the same side door as Hoon, each lugging a box of tapes.

Reek and I stood up, then began gathering up our papers and stuffing them into our briefcases. Once the table was cleared, I pulled the snapshot I'd taken of the Thing from its slot.

Reek peered over my shoulder as I stood there staring at it.

He sighed. "What a day."

"Oh yeah," I agreed gloomily, trying to imagine how Dave and Lettie were going to react to this gold and black bombshell. They say seeing is believing, but this....

Reek patted me on the back. "Cheer up, Glin. At least I know what we ought to do next."

"What's next?"

"Go get hotel rooms, and after we check in, head straight for the bar."

I nodded. "Sounds good. But the way we look maybe room service would be a better idea."

He hoisted his briefcase off the table. "You're probably right. Like it or not, the school is picking up the tab."

I took a last look at the blank onyx slab of the TV, then down at the inexplicable picture in my hand. I shoved it in my pocket and picked up my own battered leather attaché.

"The shape we're in now," I said, "It ought to be covered by our health plan."

On a rainy Saturday morning forty-one days later, Reek picked up the phone and prepared to punch in the number Hoon had given us.

We were in our off-campus workspace, the cavernous cellar of a defunct department store. Dave and Lettie were there with us, which meant that the whole Hell Creek Gang was on hand.

Dave, as I said before, is my husband. A rangy, rawboned, sun-browned man who could pass for a Remington Cowboy, he has spent his whole adult life on fossil digs. The college pays him an insultingly low salary to manage and protect the fossil beds it owns—the very beds which led it to start our tiny program almost fifteen years ago. Although his highest academic achievement is his GED, he knows as much about the arcane art of excavating fossils as Reek or I.

When we're in the field he rides

herd on the novice student diggers, handles the heavy machinery, sets up and manages the camp, acts as onsite EMT, oversees the protective packing, crating and transport of specimens, and is in general such an able assistant that I married him so I could always get his services at a bargain rate.

Letitia Serafina Davis is black, beautiful, and brilliant. A Kansas farmgirl who caught the bug when she started wondering what those funny looking things were in the rocks her father turned up when he ploughed, she's the brightest student ever to pass through our little program. Our program's main thrust is teaching proper field technique. Where most students move on after a semester or two of the back-breaking, callous-raising, glamorous side of paleontology, she's stayed to become part of the family, now doing her graduate work in Late Cretaceous extinctions with us.

Reek and I had been pulling every string we could to get the college to open a third faculty slot for her. Even before all this happened she was destined to become a big name in the field; besides an almost supernatural ability to sniff fossils from solid rock, she has that ideal combination of patience, passion, and perseverance it takes to spend two weeks on your knees in the broiling Sun, eating dust and courting sunstroke as you painstakingly free a single bone from solid rock with a toothbrush and dental pick.

Our workplace was a disaster area. It had started out a mess, crammed with worktables and mold-making

supplies and crates of specimens and camping equipment and several tons of other assorted stuff. With all four of us cooped up in there wrestling with the enigmatic Thing for the last forty days and nights, we had completely trashed the place.

We had also trashed ourselves. Each of us had been working around the clock since the TV session, quite often even sleeping there on a jumble of foam pads in a dark corner. When we took time out to eat, our diet consisted of coffee, diet soda, beer, take-out, and microwaved TV dinners. I'd lost ten pounds. Both Lettie and I had started smoking again. Reek had begun chain-gobbling antacids and having these little blank-eyed fugue states. Dave had been forced to start wearing reading glasses. I liked the scholarly way they made him look, but he hated them.

We were acutely aware of the irony of our situation. Reek and I had gathered an incredible amount of groundbreaking information on dinosaurs, yet we had hardly looked at it, giving it little more than a quick once-over before releasing the bulk of it to our impatient colleagues to keep them off our backs. We already knew of over two dozen papers based on our materials about to be published.

From us, *nada*. We had barricaded ourselves in, studying the one thing on those tapes that *wasn't* a dinosaur or a natural part of their lives. Everywhere you looked we had photos of it tacked up, more often than not caught in the act of killing.

Instead of revelling in revelation like our colleagues were, somewhere

in the first few days of our investigation a sort of clenched-teeth grimness had descended over us all.

You have to remember that we were all dinosaur lovers, even though for most of our lives the closest we could come to them was coaxing their fossilized remains from the unforgiving ground; in a way, that was giving them a chance to live again.

Still, they were all dead, and had been so for at least 65 million years. We had no illusions that they had lived like cute Disney animals. Their lives had been harsh and violent; driven by hunger, plagued by parasites and disease and predators both large and small, the fiercest among them hostage to weather and food supply and instincts that quite often led them to their deaths.

But this Thing, whatever it was, had walked and flown among them, cold-bloodedly and systematically slaughtering them. Sometimes singly, and at other times swooping down from above and wiping out whole herds in a matter of minutes. For all their size and splendid adaptation to their environment, they had been no match for its weapons and intelligence. It had picked them off like a professional sniper with a telescopic-sighted laser-guided assault rifle knocking over tin ducks in a carnival shooting gallery.

We began to *hate* it, and the more we learned, the deeper that hatred grew. We pursued it through that final tape like cops backtracking the trail of a serial killer, obsessively documenting every detail of its crimes.

We thought we had it figured out. We didn't like our hypothesis; it flew

in the face of everything we believed or wanted to believe. But the evidence was there, and we'd decided it was time to see if the inferences we'd drawn from it were on the mark.

"Forget the number, Reek?" Lettie called from over at the coffeemaker.

Reek snapped out of his little space-walk with a start, and grinning sheepishly, finished punching in Hoon's number.

"ET phone home," Dave muttered beside me. Although too macho to admit it he was even more nervous about meeting a real live space alien that I had been. Still, he was holding up pretty well. After all, this was the man who had thrown up twice on the way to meet my parents for the first time.

"It's ringing," Reek said, hand over the mouthpiece.

Lettie returned to our table with fresh coffee for each of us. "Maybe we'll get her answering machine." She pushed her intricately beaded dreadlocks out of her eyes and mimicked a nasal-voiced phone operator. "Sorry, but I can't come to your planet right now. Please leave a message and I'll call back next time I'm in this galaxy."

"Hey, someone's—" Reek said, standing straighter and uncovering the handset. "Hello? This is Dr. Enrico Gruen. I—"

He listened intently for several seconds, nodding in that pointless way people do while listening to the person on the other end. "That's right, we—"

Another long pause, a frown appearing on his face. "Let me check."

128 feet and two floors away you'll still get great sound from your stereo... no wires!

Amazing new technology gives you the power to broadcast your favorite music through walls, ceilings and floors to wireless speakers anywhere in or around your home.

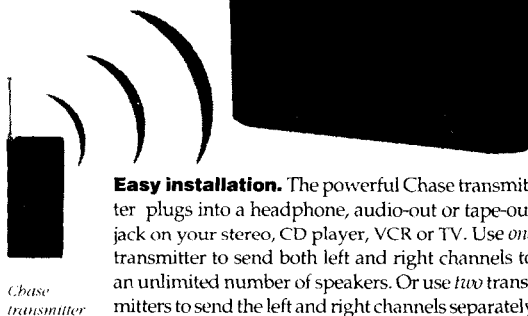
Now you can listen to music anywhere in or around your home without lugging around heavy equipment or stringing wires.

Imagine listening to your favorite CDs, records, tapes, radio station, or TV show anywhere in your home. Step into the pool or hot tub and have a self-contained wireless speaker right there with you.

State of the art sound. These wireless speakers will work with any stereo, TV or VCR. Each one has its own volume control switch, separate treble and bass controls and a built-in receiver and amplifier, so no wires are needed. Designed in an "acoustically balanced" bookshelf size (9H x 9.5W x 3.75D") they operate on four 'D' batteries or with an optional AC adaptor.

Each speaker delivers a peak of seven watts per channel, for a total of fourteen watts when two speakers are used together for stereo sound. They have a built-in crystal-control frequency mechanism to lock on the signal. *These wireless speakers are also self-amplified, so they can't be blown out no matter what your stereo's wattage.*

Patented technology. This patented FM technology allows a single transmitter to broadcast to an unlimited number of speakers within a 150 foot radius, giving you music throughout your home.



Easy installation. The powerful Chase transmitter plugs into a headphone, audio-out or tape-out jack on your stereo, CD player, VCR or TV. Use *one* transmitter to send both left and right channels to an unlimited number of speakers. Or use *two* transmitters to send the left and right channels separately to get full stereo separation on as many pairs of speakers as you want.

'No Questions Asked' guarantee. With every product from Comtrad, you get a *complete "No Questions Asked" 30 day money-back guarantee.* The wireless Chase speakers also come with a 90 day manufacturer's warranty. If you're not completely satisfied, return them for a full refund.

Chase Transmitter \$29 \$2 S&H
Chase Wireless Speaker* \$79 \$6 S&H

**Discount of \$10 on each additional speaker you order. You need one transmitter to operate speakers. Two transmitters and two speakers are needed to broadcast in stereo.*

Please mention promotional code **071-AS 1121**.

For faster service, call toll-free 24 hours a day.

800-992-2966



To order by mail send check or money order for the total amount including S&H. Or enclose your credit card number and exp. date (VA residents add 4.5% sales tax).

Comtrad Industries 2820 Waterford Lake Drive Suite 106 Midlothian, Virginia 23113

He covered the mouthpiece with his hand. "She wants to know if we have any beer."

"I think so," Lettie told him. "Dave bought a case yesterday, and I didn't drink it all."

He uncovered the handset. "Yes, I believe we do." He listened for several seconds, then said, "All right, we'll be here. Goodbye." He hung up looking bemused.

"Well?" Dave demanded. "What'd she say?"

Reek scratched his chin. "She said to hang loose, she'd be along faster than a photon with its ass on fire."

"All the way from Washington?" Lettie asked.

He shrugged, digging into his pocket for his roll of Tums. "Apparently."

"Then the least we can do is double-check the beer supply." Lettie got up, going over to our beat-up old fridge and peering inside. "Yup, we've got a couple dozen Buds and one Anchor Steam—dibs on the Anchor."

Dave was staring at me. "This is getting pretty weird, love. First the Thing, and what we think it means. Now we've got a beer-drinking alien beaming herself over to visit us."

I patted his hand. "I couldn't haul you out of here with a forklift." It was true. He was as obsessed as the rest of us. He and Lettie had been putting in sixteen hours a day separating the compressed images on the session tapes, transferring them to regular videotape, and using a video toaster, computer and color printer to provide documented stills. It was all

those hours peering at a computer screen that had ruined his eyes.

Reek's and my job had been more statistical: counting the Thing's kills we had documented; separating them by time, genera and location; and from that extrapolating just how wide a swath it had cut. The numbers were chilling.

He grinned at me. "No, I don't suppose you could."

Reek flopped into the chair across the table from us. "Suppose Hoon tells us we're right," he said mournfully. "Think of what's going to happen when we publish our findings. Even with all the data we have to back our conclusions, it's going to set off a—" He spread his hands, miming something exploding.

"A shitstorm?" Lettie supplied helpfully as she handed him a coffee. "Hey, we'll all be famous!"

"So is the *Titanic*," he retorted. "So is the *Hindenburg*."

"More like Custer," I suggested. "Or Napoleon at Waterloo. There's a fundamental difference between a massacre and a disaster."

Before we could get really rolling on this subject there was a knock at the door. We all froze, everyone looking at each other but no one making a move to answer until Lettie got up.

"I know," she said, heading for the door with a queenly toss of her dreadlocks, "let the lowly graduate student get it." She opened the door, and eyes widening in surprise, stepped back.

Hoon bustled in past her, sans chaps and gunbelt, but still wearing the white ten gallon hat. "Greetings,

Earthlings," she called cheerily. In her lower arms she carried a neon orange picnic cooler, in her upper left a plastic bag of peanuts, and in her right a quart-sized mug emblazoned with the motto: *I BET YOU CAN'T* and filled with cigars.

Even Reek and I were taken aback by her appearance. Except for where the crown of her head was covered by her cowboy hat, every feather on her body was standing quiveringly on end.

Lettie recovered her composure and reached for the cooler. "Here, let me give you a hand."

Hoon peered at her with one bright black eye. "You don't think four are enough?" But she handed the cooler over, piling the other stuff on top. "Love your hair. What's your name?"

"Lettie. Lettie Davis."

"Any relation to Miles?"

Lettie chuckled. "Sorry."

"Hey, neither am I. Come on honey, drag that cooler over and we'll crack us some brewskis." She started toward the table where we were sitting, using her now free hands to brush her feathers back in place. "Can you believe it, five hundred years we've had matter transmitters and they still mess up your 'do."

Reek stood up and offered his hand. "Pleased to see you again, Hoon. Thanks for coming."

"Tickle me right and I always do," she said, shaking his hand and looking past me at Dave. "This must be your better half, right, Glinda? Quite a hunk." She offered her other right hand to him. "How're they hanging, handsome?"

Showdown at Hell Creek

Dave blushed and shook her hand. "Pleased to meet you, ma'am," he mumbled.

"Well trained, too." She gave me an approving look that any female, regardless of species, would recognize. "I like that in a male." She released both Reek's and Dave's hands, gave me a sisterly one-armed hug and then settled herself into the chair between myself and Lettie.

Lettie had opened the cooler, and began uncapping and passing around the ice-cold bottles of Beck's inside. Hoon took the beer Lettie gave her. "Thanks." First she took a long slug, then said, "OK folks, time for show and tell."

I nodded and leaned forward, the others watching me with poker faces. This was the moment we'd been dreading. We'd worked our butts off on this, and if we were right, the implications were enormous. Explaining our conclusions was my job because I'd lost last night's dice toss. So I took a deep breath and plunged in. "First conclusion: The Thing is of extraterrestrial origin."

Hoon smiled. "One point for your side. And?"

"We think it's a device, like a robot or something."

"Why?" Hoon offered each of us a cigar from her mug. We all declined. She extracted one, peeled off its wrapper, and began munching it like a stick of black licorice. Reek took one look and started patting his pockets, searching for his antacids.

"The data is spotty, of course," I said carefully, "but in the over one hundred year span covered we didn't

once see it eat, sleep or excrete.”

“And you don’t think it was an anorexic insomniac with centenary constipation.” She cocked her head. “Which reminds me, did you hear about the dyslexic insomniac agnostic?”

“No,” I said uncertainly.

Hoon shook her head sadly, nipping off another chunk of cigar. “Tragic case. The poor schmuck lies awake all night staring at the ceiling and wondering if there’s a dog.”

It took several seconds for that to hit bottom. Lettie got it first and guffawed, Dave joining in a split second behind her. Reek and I brought up the rear.

When we stopped laughing the level of tension in the room had lowered considerably.

“You’re probably right,” Hoon said once we had quieted down. “While we suspect that the Bastard had an organic component, we’ve never been able to prove it. All we know about what they were like is what we’ve seen on TV.”

“You said *were*,” Dave put. “Does that mean they’re extinct?”

Hoon took a meditative sip of her beer. “We think so, and to be perfectly honest, we kinda hope so. But we can’t be sure. We’ve found TV evidence of them on thirteen planets so far, including yours and ours, the most recent visitation about fifteen million years ago.”

She shrugged. “We get around, but we sure ain’t been everywhere, seen everything, and met everybody twice. There could be more recent evidence out there waiting for us to

trip over it. Hell, they could have a Club Med a dozen suns away from here and we just haven’t seen the flags on their golf course yet.”

“Can’t you backtrack their arrival or follow them after their departure with the TV?” I asked.

Hoon shook her head. “We wish. The thing is, time and mass affect each other. You need concentrated mass to collect time residue, so the TV only works inside a gravitational field, and can only read what has happened inside it. Up to a certain point the stronger the field, the further back the TV can scan. Too much gravity warps time out of focus. Too little and we can’t see more than a few piddly centuries back.”

“In other words,” Reek said quietly, “you can’t use the TV to look for these monsters in space.” He took off his glasses and began polishing them. “They could be skulking around out there and you’d never know.”

Hoon nodded. “Reassuring thought, isn’t it? So tell me, have you figured out what it was doing here?”

The others waited for me to answer. “Killing dinosaurs. Continuously and systematically. Apparently trying to eradicate certain kinds, and from what we could tell from what little data we collected, making progress.”

“Any idea why?”

I sighed. “We’re still not sure. It didn’t eat them. That first night after our session when we’d had only a brief glimpse of it in action, Reek and I thought maybe it was taking the heads for trophies. Human hunters do that, and it would also help explain

why fossil skulls tend to be rare. But once we got back here and started studying the tapes that theory went up in smoke. It would just shoot a dinosaur, find another and shoot it, then another, and another, day and night, day in and day out for the whole time period we recorded. It doesn't really make any sense."

Hoon clacked her beak in laughter. "Doesn't it? In this country alone children and adults spend billions of dollars a year, one quarter at a time, blowing poor innocent space aliens to pixellated smithereens. Does that make sense?"

Reek leaned forward so fast he nearly knocked over his beer. "You're saying that killing dinosaurs was like a *video game* for that Thing?" He sounded appalled by the idea, which pretty well summed up how it struck the rest of us.

"No," Hoon replied, "You said it, and you're right."

"Wait a minute," I said, "If that Thing came here to slaughter dinosaurs for who knows how many hundred years as some sort of game, where's the sport? What makes it a game?"

Lettie answered my question. "The game was to wipe out certain species of dinosaurs before its quarter ran out."

"Huh?" Both Reek and I said in unison. But Dave nodded.

"Sure," he said, addressing Hoon instead of us. "And that might be why there aren't any of those Things around any more."

"What the hell are you talking about?" I demanded.

"The Event, hon," he answered patiently. "It was playing Beat the Clock with the asteroid strike that brought the Age of Dinosaurs to a sudden close."

I had to sit back and take a drink, staggered by that conceptual cinderblock. Everyone waited to see what I would say. "Then—then it knew the strike was coming," I stammered. "Several centuries ahead of time." I stared at Hoon. "Is that possible?"

"Does our calling them Opportunistic Bastards tell you anything? There are even some of us who wonder if maybe they ever gave any of these cosmic spitballs a little nudge to steer them the right way."

We four humans were quiet for almost a minute, sitting there and drinking our beers as we mulled that awful idea over. It was Lettie who broke the silence.

"Could they read the future the way your people read the past?" she asked quietly.

"Why do you ask?"

"Two reasons. The first, that would be one way of knowing the Event was going to happen, although a knowledge of orbital mechanics would give the same information. Secondly, the Bastard seemed most interested in killing certain kinds of dinos—the big carnosaurs, sauropods, and ceratopsians. Was that because it knew they weren't going to survive the Event's aftereffects anyway?"

Hoon smiled at her, the feathers at either side of her beak spreading wide. "Excellent question, m'dear. One that's been bugging me for years. I wish I had an answer."

"How about this one, then," I said tightly. "Did that miserable Bastard die in the Event?" I hoped it had. The more I thought about it coming here and cold-bloodedly picking off our dinosaurs as part of some murderous game, the madder I got. Glancing around the table, I could see that the hatred of the Thing we shared had them all hoping its gold-plated ass had got hammered flatter than a penny on the railroad tracks.

Hoon shrugged. "How should I know?"

I just stared at her. "You're the ones who control time viewing technology. All you have to do is *look*."

She shook her head no. "Sorry, but it's not that simple."

"Why the hell not?" I snapped.

"Easy, love," Dave said softly, reaching over and putting his hand on my arm. He knew how frayed my temper had become over the last forty days, having been chewed out several times for no real reason. At that moment Hoon seemed to be acting deliberately uncooperative.

So I lit a cigarette, counted to ten and tried again. "Why not?" I asked sweetly. Or semi-sweetly.

Instead of giving me an answer, Hoon asked, "Do you read your husband's mail?"

"No," I said uncertainly, missing her point completely.

"Well," she replied patiently. "We won't read yours, unless you ask us to open it and read it with you."

"Sure," Lettie said, nodding. "That makes sense."

"Then why don't you explain it to us?" I growled peevishly. Reek nod-

ded in agreement with me. Dave had a thoughtful look on his face.

"OK, I will. You and Reek told Dave and me about the things Hoon said after your session. Their scruples about letting us find out things for ourselves. Well, just because their past is an open book to them, that doesn't mean they assume they have a right to stick their noses—beaks, rather—into ours. The whole Time Viewing project was started because they want us to use their technology to look into our past not only so we can learn about it, but so *they* can too. Remember her thanking you for the look into our past? She couldn't have taken it without our asking to see it."

She gave Hoon a knowing smile we'd all seen before. "She's told us in so many words that her people are very interested in the Bastards. Yet their investigation of our visitation has gone only as far as ours has. Right, Hoon?"

"Kee-rect, kid." She began rummaging in the cooler, pulling out and opening a fresh beer for each of us by snapping the caps off with her beak. She snickered at the horrified look on Reck's face, tapping her beak with one finger. "Hey, if this isn't proof evolution works, then I don't know what is."

I took a sip of the beer she gave me, then looked her straight in the eye. "I think I get it now. You're allowed to help us see things, but not to explain them. You couldn't really talk about the Bastard with us until we figured out at least part of it on our own. Now we have, and I'll bet

you dollars to doughnuts you're just waiting for us to request more TV time so we can learn everything we can about this miserable sonofabitch. That way *you'll* be able to find out more about it."

Hoon regarded me with one sparkling black eye, the feathers at either side of her beak twitching as she tried to suppress a smile. "What if I am?"

That was one hell of a question. I already knew my answer. I looked around at the others. Lettie nodded and held up a clenched fist. Reek bobbed his head excitedly, grinning from ear to ear. Dave gave me a fond smile, and repeated the first words he'd said to me when we first met on a dig many years ago.

"You're the boss, Doc."

I turned back to Hoon, smiling myself. "It appears that the Hell Creek Gang is ready to saddle up and chase us a gold and black bad guy."

"All *right!*" Hoon chirruped, thumping her beer on the table. She began passing out cigars. "Meeting's over! Let's party!"

We did, too. But we also laid some serious plans before things degenerated too far.

The Ri'C'ka may look birdlike, but let me tell you, that Hoon can drink like a fish.

So that's how we got to where we are now, the four of us becoming Earth's first Bastardopaleontologists.

A half dozen Ri'C'ka and an equal number of human techs came earlier today, setting up an eight by eight Time Viewer and the recorders to go with it for our exclusive use. It was

like having the Marx Brothers, the Three Stooges, and Monty Python in here all at once, but we survived.

For the first time in our careers, funding isn't a problem. The Ri'C'ka are underwriting our research. We leased the whole building to make room for press flacks, security, technicians and all—a whole little circus all our own. Hoon, whose specialty (surprise surprise) is Bastard research, is moving in tomorrow to become an equal member of the Gang.

We've kept a pretty tight lid on our findings so far, but that's about to come off. Paleontology is about to undergo a rather noisy revolution as one of its fundamental questions gets a very unlikely answer.

We're quite sure our colleagues are going to go bananas when all the letters and articles we've churned out in these two weeks since Hoon's visit go public all at once.

Reek wrote articles for *Nature* and *Scientific American*. Dave wrote for *Popular Science* and *The Whole Earth Review*. Lettie wrote for *National Geographic*, and she and I co-authored letters and packets of data to various museums and Universities. Besides working with her on that project I of course had the honor of writing this messy little science fact article for my favorite SF magazine. And I bet you thought it was fiction, didn't you?

Capping it all is the paper that we all wrote together, and which will run in one of the premier paleontological journals.

We rolled the dice to see whose name got listed as author. Lettie lost.

That meant she also got the honor of titling it.

It's going to raise some hackles, but it does have a nice ring to it, and I suppose it's just the sort of thing you'd expect from a research group calling itself the Hell Creek Gang. Hoon has already gotten us each a white ten gallon hat to commemorate her joining us as we try to document the Bastard's crimes and find out if its quarter ran out during the Event.

We may not be strictly paleontologists now, but we might just get a chance to do some digging if it did. All we'll have to do first is track its remains across a mere 65 million years.

That will just take patience, passion, and perseverance.

Oh yes, I suppose I should tell you the title of our paper in case you want to read it.

"Dinosaur Population Decline in the Late Cretaceous Reconsidered in Light of New Evidence: *The Lone Gunman Theory*."

Not that it's just a theory, but we figure it's best if we let them find that out for themselves.

Author's note: A tip of the Ten Gallon Hat to Commander Rick (Enrico Gruen) Green and his TVOntario show "Prisoners of Gravity" for the story idea. ■

To state the facts, however, and then to bury them in a mass of other information is to say to the reader with a certain infectious calm; yes, mass murder took place, but it's not that important—it should weigh very little in our judgments.

A People's History of the United States
Howard Zinn

[In] a world of conflict, a world of victims and executioners, it is the job of thinking people . . . not to be on the side of the executioners.

A People's History of the United States
Howard Zinn

[Throop & Sons, Marsport, Krasnya Rep. (2394 AD)]

From the TRAVEL DIARY AND SKETCHBOOK OF BRAXTON MONTAGUE SHEW III



Zhburtz'ming of Gawain

[Throop & Sons, Marsport, Krasnya Rep. (2394 AD)]

My dear Mater,

Our ship has made a brief layover in Gawain, in the Camelot Sector, affording the passengers the opportunity to stroll a bit through the port city and see a few of the sights. The Sussurium was, of course, every bit as magnificent as its reputation; but the tomb of Gwen'vere VII disappointed. My traveling companions, Umberto from Rome and M'bwurto from Natal, and I went slumming in Birdtown after supper to view the natives, or *zhburtz'ming*, as they charmingly call themselves. We came across a group of them engaged in some sort of open air ritual in which one *zhburtz'ming* undertook to strike with a stick a small sphere thrown by another. I have enclosed a sketch of one, called the *bad'ha* in their tongue. Each time the *pid'zha* threw his sphere, the worshipers would chant, "*Zhving bad'ha, bad'ha, bad'ha.*" It seemed pointless to me, but the worshipers were very intent and often went into religious ecstasy, shouting, "*Xildiump!*" As you can see, the *zhburtz'ming* are only superficially birdlike, resembling more a gourd with a snake's neck. The "feathers" around the lower body are actually flaps of skin, some of them so thin as to be translucent. The purser later told us that these helped the natives stay cool under the hot Gawainian sun. We never did discover the significance of the ritual, but were told by one worshiper who had some AWngloterran that the '*hum'tiim*' had won. Won what? Perhaps the favor of their gods.

Your obedient son,
Brax



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

G. Harry Stine
**COMES THE
REVOLUTION. . . .**

Illustration by George Krauter



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

In spite of crashes, politics, budget battles, and opposition from today's version of Jules Verne's Baltimore Gun Club, we're on the verge of having inexpensive, reliable, and responsive single-stage-to-orbit (SSTO) space-ships like the Delta Clipper DC-Y described in Dr. Arlan Andrews's science-fact article in the June 1993 issue¹.

Given that we can build reusable spaceships that operate like commercial airliners, what is this *really* going to mean?

In one word: *revolution*.

In the social context, the word "revolution" means a rapid and radical change in the way of doing things as opposed to "evolution" which is a slow and gradual change. And the introduction of the SSTO is indeed revolutionary, as you will see herein.

It's presumptuous to believe that anyone can fully assess the impacts of a truly revolutionary concept such as the SSTO. However, assuming that the basic technology to build SSTO spaceships exists, it's possible to look at how SSTO spaceships will (a) reduce the costs of space transportation, (b) change the way we conduct operations in the Earth-Moon system, and (c) impact allied areas that haven't been considered when operating with expendable space launch vehicles.

Although an SSTO spaceship hasn't flown yet, it's prudent to begin looking at the consequences of this space transportation revolution. It is *not* too early to look at the business economics of the revolution.

(The question was unreliably reported to have been asked in the Continental Congress, "Mister Chairman, as the delegate from New Hampshire, may I ask if this revolution is going to cost very much?")

And given the lightning speed with which our political, regulatory, and legal systems operate, is it wise to leave political, regulatory, and legal questions unresolved until the last minute? We may end up having the technology for a cheap, reliable, and reusable SSTO spaceship but be unable to use its services or even fly it!

The Technology Is Immaterial

First off, assume that the basic technology to build SSTO spaceships exists. Leave it to others to focus on technology; they love the technology. However, even after nearly two decades of people like me admonishing them, they still don't understand that technology alone isn't going to make it happen. Where specific technological problems presently exist, aviation history says that a reasonable number of flight tests with prototype X-vehicles can provide engineering solutions. Build 'em, boost 'em, and bend 'em . . . and name a few more streets at Edwards Air Force Base for courageous former test pilots.

Furthermore, the specific SSTO technology used is immaterial. For example, the exact operational modes—VTOVL, VTOHL, HTOHL, nose-first entry, tail-first entry, etc.—influence only the type of required spaceport facilities, not their extent.

Basic assumptions about a generic SSTO include:

- Propellants are liquid oxygen and liquid hydrogen with no auxiliary propellants.
- The airframe, propulsion, avionics, and other on-board systems are completely reused.
- Turnaround between flights is no longer than 72 hours.
- A ground crew of 50 technicians and mechanics per flight is required.
- Operations involve only aircraftlike procedures from austere "flight simplex" facilities.

The Economy, Stupid!

Listen up! The first lesson: The space transportation revolution will not occur unless someone can make money flying spaceships.

For the last thirty years, space transportation has been operated and controlled by the federal government as a part of national security. However, with the end of the Cold War, it's too expensive to continue doing it the old way. And this socialized space transportation system has retarded progress. It has been 35 years since NASA was established. This is the same period that existed between the first government air mail flight with DeHaviland DH-9 biplanes in 1919 and the first flight of the Boeing 707 prototype in 1954. Anyone who claims that space technology is more complex than aeronautical technology simply doesn't understand what went on between 1919 and 1954.

The federal government has shown it cannot operate a spaceline any more than it could (or did) operate a

national railroad or a national airline. Private enterprise did and does. With the SSTO, it's going to make more sense to let private enterprise engage in profitable space ventures.

However, the bad news is: *Perceived risk* is high. The good news is: It has *always* been high! In the past, high-risk ventures with new technology have used a proven risk reduction procedure: Modest government research funding and incentive programs to reduce risk. Railroads got government guaranteed loans and land grants. Airlines got airliners built using government research findings and air mail contracts to help them get started. The government is presently continuing this historic procedure by funding experimental SSTO test vehicles.

As we have learned in the past 35 years, few things get done well and economically without the profit motive. Before we go any farther, we must determine the attractiveness of the business opportunity of providing civil and military space transportation. Therefore, we must first answer the question: *Can someone make money doing it?*

The answer to this question rests with the size of the market opportunity. This is, in turn, dependent upon the nature and price of the service offered by spaceship operators. The market opportunity and the price of the service are interconnected by a feedback loop. One affects the other.

With this principle in mind, The Enterprise Institute, Inc. in Phoenix, Arizona developed a space transportation economics model designed to

answer the questions an investment broker or a banker would ask the organizers of a prototype spaceline who are raising capital to buy a fleet of SSTOs². A banker or investor wants an answer to a simple question: *Am I going to get my money back?* In short, what's the risk? Can the service be sold? Is there a market? He will ask additional questions that will get him an answer to his first question.

What Is The Market?

The effect of introducing a new product or service into any market ranges from zero to revolutionary. An evaluation requires answers to several questions before the effect of a new product or market opportunity can be assessed. These include:

- **WHAT**—*What is it and what will it do?* For the purposes of this analysis, a first-generation SSTO spaceship will transport up to 10 tons of cargo and/or passengers into low-Earth orbit and back every three days.

- **LIMITS**—*What won't it do?* In terms of its limitations, a first-generation SSTO spaceship will not be configured to accommodate very large and bulky payloads. Payload support services for cargo will be limited as is the case with current cargo services provided by airline operators. Customers must supply their own specialized cargo support.

- **AVAILABILITY**—*When, where and how easy is the product or service to obtain?* Each SSTO will provide service at regular intervals of three days. A full payload bay won't be required for a flight. Service will be provided from several spaceports.

Weather will be no more of a problem than it is for subsonic commercial air transportation.

- **PRICE**—*How much will it cost?* This raises the key issue: How much will a commercial spaceship operator need to charge for the transport service? How does this price compare to alternative transport services to low-Earth orbit?

The required revenue per flight can be determined if the following performance and financial information is known.

(A) CAPITAL EQUIPMENT COSTS—Spaceship, ground support equipment and facilities, spaceship life, and facilities life.

(B) OPERATING COSTS—Marketing, G&A, insurance, spaceship maintenance, crew and ground personnel, and fuel.

(C) FINANCIAL COSTS—Competitive return on equity and cost of debt.

(D) CAPITAL STRUCTURE OF THE BUSINESS—Debt to equity ratio.

(E) PERFORMANCE DATA—Weight profile, fleet attrition, and flight rates.

The Enterprise Institute financial model was designed to allow variation in inputs to determine factors having the most significant effect upon the required revenue per flight.

One other point about the financial model: It was assumed that, at the end of five years, the business was totally liquidated. The model shows no value for residual costs, market position, or used equipment.

For a first-generation spaceship, the differences between a commercial vehicle and a military vehicle converge. Thus, if a first-generation



Could this be your dog?

Finally you can protect your dog from traffic and other dangers without locking him up in a pen.

All dog owners have the same dilemma. They want to give their dog the freedom to roam and exercise, but they worry about his safety. Up until now the only solution was to install an expensive and unsightly fence. Not anymore!

Affordable alternative. Now there's Radio Fence, the breakthrough alternative for dog owners. Radio Fence is an underground electrical barrier which works with a receiver on your dog's collar. It keeps your dog as he hears the boundary and gives him a small electrical correction if he tries to cross it. It keeps your dog safe without having to resort to expensive fences, runs ropes or chains that could injure your pet.

Radio Fence gives your dog access to the whole yard but inhibits his movements into unwanted areas like your rose garden or pool. Unlike standard fences, Radio Fence does not detract from the beauty of your home or lawn.

How it works. A transmitter plugs into an outlet and emits a radio signal that travels along an underground wire. (The wire needs to be buried only an inch or two.) The four-ounce receiver worn on your pet's collar picks up the signal and alerts him as he nears the boundary. If he crosses it, he'll receive a short correction similar to a static electricity charge.

Custom boundary. You'll receive 500 feet of wire which installs in just two to three hours. The wire accommodates up to a half-acre yard. The system also includes a transmitter powerful enough to broadcast within two acres. Additional wire is available.

Easy training. Working with your dog fifteen minutes a day will fully train him in about a week. Train as many dogs as you want on the same system as long as they are each wearing a receiver collar.

Try it risk free. Radio Fence is backed by our "No Questions Asked" money-back guarantee. If you're unsatisfied, return it within 60 days for a full refund. It also has a one-year manufacturer's warranty.



Radio Fence includes transmitter, lightweight receiver, antennae, boundary cable, installation and training manual and video..... **\$198** \$16 S&H

Credit card customers **3 payment of \$66** \$16 S&H

Please mention promotional code **032-AS1122**.

For fastest service call toll-free 24 hours a day

800-992-2966



By mail- send check or money order for the total amount including S&H (VA residents add 4.5% sales tax) or charge your credit card by enclosing your account number and expiration date. Send to:

Comtrad Industries
2820 Waterford Lake Drive Suite 106
Middlethian, Virginia 23113

spaceship is designed to satisfy military and civil customers—as was done with the Boeing 707—a manufacturer can spread his non-recurring costs over a wider base. This in turn will reduce the cost of a spaceship and make it even more economically viable in the commercial sector. Furthermore, satisfying both types of customers through convergence not only lowers development costs but reduces the risk involved in developing the technology. The bankers will like that.

The most realistic run with the model used the following key assumptions: A spaceship costs \$500 million (1993 dollars), has a life of 500 flights, requires 1,200,000 pounds of liquid oxygen and liquid hydrogen per flight at a cost of \$0.50 per pound, and has an annual flight rate of 100 flights. In addition, a conservative debt to equity capital structure of 33% debt and 67% equity was assumed for the business. A competitive pre-tax return on equity requirement was pegged at 16%.

The results are impressive.

The total required revenue per flight for placing 10 tons of cargo and/or passengers into LEO is \$1.6 million (1993 dollars). In terms of passengers, this works out to be \$14,500 per person for a round-trip ticket to low-Earth orbit. (If you want to go, you don't buy a new car that year.)

This represents a price about 1% to 3% of current launch services.

But is this reasonable? What assumptions exert heavy influence on the competitive posture of a reusable

spaceship relative to expendable and semi-expendable vehicles? Various sensitivity analyses identified those factors that have the greatest effect upon the required revenue per flight—that is, they identified the economic “drivers.”

Financial model inputs of particular interest were spaceship purchase price, propellant cost, spaceship life, and number of flights per year.

The price of *anything* varies according to the number of production units over which development costs will be recovered, the recurring cost of production, and the associated production learning curve. The cost of propellants depends on the overall demand for them. The flight rate is determined by spaceship design. Spaceship designs that have longer life and allow faster turnaround influence the revenue needed to provide an attractive return on investment.

The results of the sensitivity analysis are interesting:

- A five-fold increase in the price of the propellants from \$0.50 to \$2.50 per pound caused the required revenue per flight to increase to \$2.2 million from \$1.6 million, a 38% increase.

- When the propellant price of \$0.50 per pound was maintained, but the price of a spaceship was tripled from \$500 million to \$1.5 billion, the required revenue rose from \$1.6 million to \$4.2 million, a 163% increase.

Of the two inputs, the purchase price of a spaceship clearly is the significant economic driver.

It is important to note that in the

case of a fuel price of \$2.50 per pound and a spaceship cost of \$1.5 billion, the resulting required revenue of \$4.7 million per flight remains a fraction of the cost of service using expendable and semi-expendable launch vehicles.

Other sensitivity analyses showed great flexibility between spaceship cost, spaceship life, and spaceship flight rates.

For those who believe that certification costs could seriously skew the model's results, these factors were taken into account. The increased development costs simply increase the basic spaceship cost from, for example, \$500 million to \$700 million, or from \$1.2 billion to \$1.4 billion. This means that the prospective operators will have to do a little more work when talking to the bankers. The model was run with a spaceship cost of \$2 billion. In such an example, the financial community is likely to conclude that the venture is slightly more risky. Therefore, they'll want it to be more heavily equity oriented and with a greater after tax return on equity of 20 + %. In this case, the required revenue became \$10 million for 10 tons, still extremely competitive against existing expendable systems.

The sensitivity analysis underscores what every airline in the world knows: *Keep the airplane flying*. The primary economic driver is the cost of the equipment and the efficiency of its use. Operating costs such as fuel become more important only when all competitors are using vehicles of a similar nature.

Although further financial analysis of spaceship characteristics and economics will define the exact nature of the costs, operating profile and resulting required revenue, the basic conclusion will still stand:

A spaceship with performance and cost characteristics in the ballpark with those outlined will hold an overwhelming price advantage over any expendable or semi-expendable space transportation system. The flexibility of operation inherent in an SSTO spaceship will extend this competitive advantage still further.

From an investor's point of view, the financial analysis shows that a space transportation service using SSTO spaceships can be brought to market at a price that can only be described as revolutionary.

Lowering the price of a valuable service to between 1% and 5% of current prices is not an event that goes unnoticed in the business community.

Market Impacts and Consequences

Whenever such a major change is brought to a market, market dynamics change to a degree that causes major ripples through other markets. A good example of this is the introduction of communications satellites and their effect on the television industry, television programming, and long-distance and intercontinental telephone service. The rapid decrease in the cost of high capacity integrated circuits allowed the development of the personal computer that, in turn, created major changes in the computer industry as a whole and the

manner in which companies, both large and small, conduct business.

Similarly, the introduction of SSTO spaceships into commercial service will revolutionize the infant commercial space transportation industry. Regular and inexpensive transport services to low-Earth orbit will cause a major shift in the design and operating philosophy of satellites, space stations, space-based production facilities, Earth-lunar travel and interplanetary travel.

Present satellite design and operating philosophy is the result of three factors: (1) The high cost of getting to low-Earth orbit, (2) the lack of a significant human presence in space, and (3) the long and uncertain lead times in obtaining space transportation services.

Reducing the cost of reaching low-Earth orbit has the greatest impact. Robert A. Heinlein said it 40 years ago, and we should have paid more attention to him. When the cost of climbing out of the Earth's gravity is substantially lowered, the heavy emphasis placed upon the weight and redundancy of satellites, space stations, and other space facilities will be reduced. The decreased emphasis on very high reliability required by one-shot operating philosophies permits the utilization of less exotic materials and the application of modular spacecraft design. These factors will result in less expensive satellites and on-orbit facilities and, in turn, an increase in market demand for the services. Low cost access to LEO will also allow more energy intensive flights for orbital, translunar and in-

terplanetary travel.

A greater human presence in space will also have an effect upon satellite design. The ability to reach orbit easily and quickly permits on-orbit repair and lowers the need for heavily redundant fail-safe space-based assets. The inability to reach an inoperative orbital asset means it's "dead" from an investment standpoint. The ability to reach it quickly to repair it turns on the cash flow stream once again and lowers the burden of capital and fixed operating expenses. This, in turn, allows a lower cost to the ultimate beneficiary of the space-based operation and a greater return on investment to the space asset owner.

Going back to the opening question: Does the operation of SSTO spaceships represent an attractive business opportunity? From a financial and investment point of view, the answer is an overwhelming YES!

Therefore, an excellent case for profitable space transportation can be made. The financial and economic numbers will continue to be persuasive, no matter what sort of space vehicles are used as long as they are totally reusable single-stage-to-orbit types offering turnaround times of a few days. *The technology used to do this is immaterial.*

This is an important point to keep in mind. When a prospective space transportation company executive goes to New York City to talk to Citibank, Prudential Bache, Morgan Trust, or whoever can put together the financing necessary to build spaceships or operate a spaceline, the banker doesn't care what the tech-



WRAP UP YOUR HOLIDAY GIFT GIVING

This holiday season give a subscription to **ANALOG SCIENCE FICTION & FACT**. It's the perfect gift and it will be appreciated throughout the year.

Once a year holiday rates are now in effect. Your first gift subscription costs only \$24 for 15 issues. Each additional gift subscription is even less-just \$19 for 15 issues.

ASIMOV'S SCIENCE FICTION is also available at these low holiday rates. The first subscription costs only \$24 for 15 issues; each additional subscription costs only \$19 for 15 issues.

Gift recipients will begin their subscription in January, with a current issue.

We publish two double issues, per year. Each double issue counts as two towards your subscription.

Giving a gift subscription is easy.

**CALL TOLL FREE
1-800-333-4561**

or write to us at

ANALOG SCIENCE FICTION & FACT

P.O. Box 5133
Harlan, IA 51593

Foreign orders please add \$6.00.
Cash with order. U.S. funds only.

Y6AF-5

nology is. If McDonnell Douglas, General Dynamics or Rockwell International needs a line of credit to build spaceships, they have a track record of making similar technologies work profitably. Thus, the financier assumes the company knows what it's doing with an arcane technology he doesn't need to learn about. It's also easier if the operator has a track record. However, Fred Smith at Federal Express had no such track record when he started, just an outstanding and convincing business plan, and a large inheritance.

By looking at just the economic numbers, one fact should be obvious. The first people who build and operate SSTO spaceships will dominate space for the first half of the next century.

Space Markets

Determining a market size for SSTO spaceship services is uncertain since the market demand curve is largely unknown. One can logically and reasonably assume on the basis of historical evidence that a sharp drop in space transportation costs will produce a proportional increase in the demand for space transportation services. An SSTO spaceship transportation cost that is 5% of existing services indicates a potential annual requirement of 40 million pounds to low-Earth orbit by the year 2010.

Many factors can affect this estimate for SSTO spaceship launch services. As the aircraft and airline industries learned during the 1930s, estimating errors are more likely to

result from over-conservatism when new technologies and major shifts of economics are introduced to a market.

A look at some present day air cargo figures can help put the estimated 40 million pound launch forecast of 2010 into perspective.

In 1988 the three major airports of the New York metropolitan area processed a combined total of more than 1.8 million tons of air cargo.³ That's *3.6 billion pounds of cargo* for just one region of the world. Assuming that the air cargo market continues to grow at its steady historical rate of 2.5% per year, by the year 2010 the air cargo volume for the New York area would be about 6.2 billion pounds. The estimated 40 million pound LEO launch requirement of 2010 represents less than 1% of the projected air cargo volume of only one region of the world.

Considering the historical perspective provided by air cargo, it's not fantasy to speculate that the annual space transportation services required during the first two decades of the next century would grow far in excess of the 40 million pounds of payload estimated initially. How much in excess? This is truly anyone's guess, but the numbers could be in the hundreds of millions of pounds. Obviously, this wide range of possible futures has a bearing on spaceship fleet size and the required ground infrastructure needed to support this magnitude of operation.

Assuming that each SSTO spaceship is capable of carrying 20,000 pounds to low-Earth orbit and has a

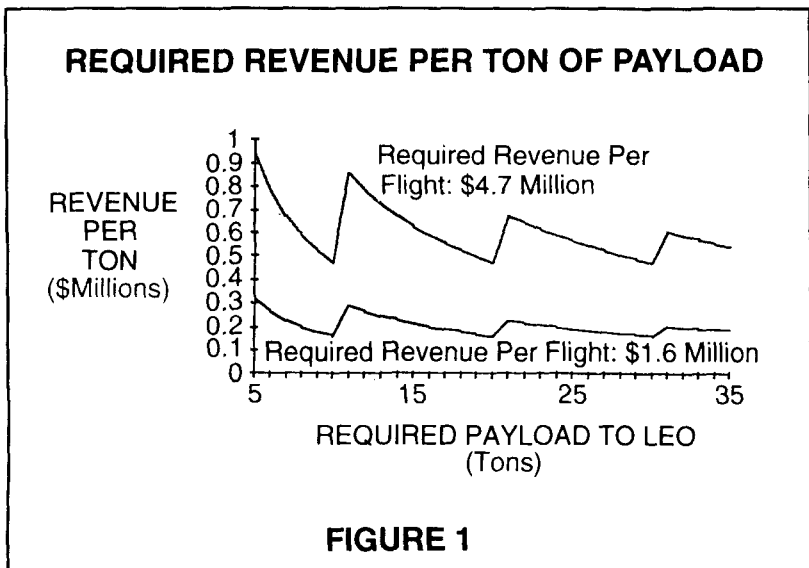
flight rate of 100 flights per year, the total fleet size required to meet an estimated market demand of 40 million pounds of payload to LEO is 20 spaceships. It's unreasonable to assume that each spaceship will have a full cargo bay on every flight. For purposes of this analysis, the result is a fleet size requirement that remains at 20 spaceships.

For a market requirement several times larger—such as 120 million pounds of payload to LEO—spaceship fleet size would increase to 60. Does this sound unbelievable considering the level of space transportation today? Not really. Orbital space promises to be an ideal environment for the manufacture of many high technology products such as electronics and pharmaceuticals.^{4,5,6}

But some of the best products from an investment standpoint will un-

doubtedly turn out to be mundane or appear to be “frivolous.” As the cost of access to low-Earth orbit decreases, the importance of the transportation portion of a space-based investment decision becomes less important. A look at the manifests of the air cargo carriers in and out of the New York area shows that they consist mostly of such “low tech” items as clothes, toys, games, vegetables, fruits, and seafood.⁷ To say that space will forever remain the domain of high technology is to ignore the business lessons of history.

When payloads heavier or larger than those capable of being deployed by a single spaceship are considered, the cost per ton is not a smooth curve. Figure 1 is familiar to people in the airline business. On the vertical axis is cost per ton where in the airline business it is normally cost per



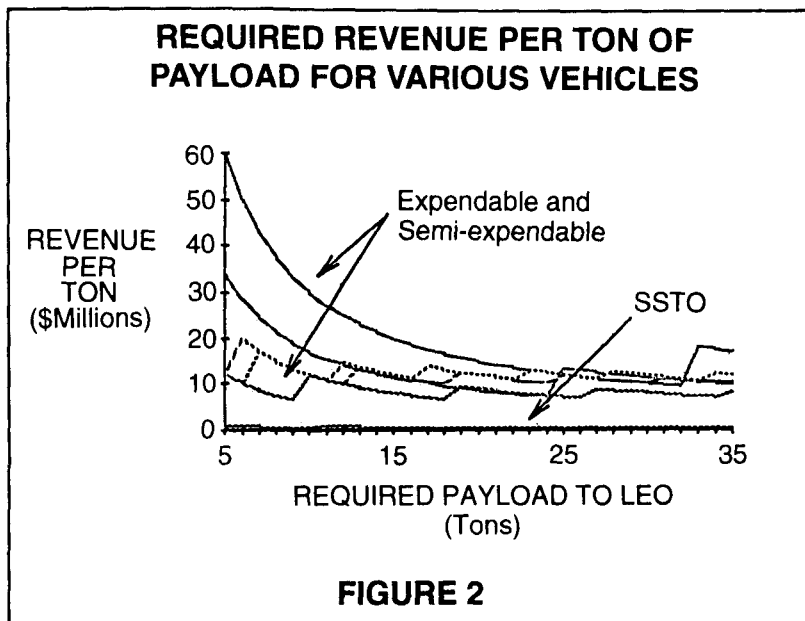
passenger. The spikes are caused by reaching the maximum payload capability of a single spaceship where a customer wants to put up 11 tons. This creates a spike in the curve because an additional spaceship must be scheduled either to lift the additional ton or to divide the payload equally between two spaceships. This obviously increases the cost per ton (Figure 1).

But when the cost per ton of orbiting large payloads in excess of the maximum payload of a single spaceship is compared to the same costs of lifting them on the existing fleet of expendable and semi-expendable vehicles such as the Space Shuttle, Titan, Atlas Centaur, Ariane, and Delta, the results are depicted in Figure 2. This dramatically indicates that any

reusable vehicle anywhere in the neighborhood of the financial characteristics and operating characteristics of the SSTO spaceship used in the model is going to force a major change in the market.

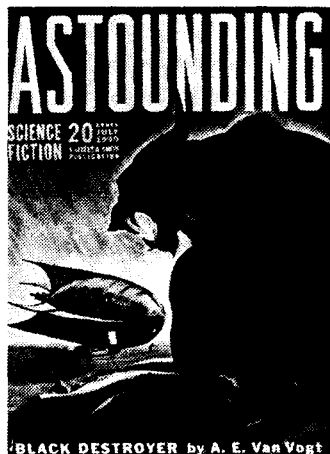
Some people may object to this analysis on the basis that much the same sort of thing was claimed for the NASA Space Transportation System, the space shuttle. However, the major difference of the Enterprise Institute analysis revolves around the fact that the designers and builders of the STS didn't have to talk to New York bankers but to people in Congress who are quite a different class of financiers.

As detailed earlier, the secret of making money with any machine is to keep it working. That's how airlines



A TREASURE FROM THE GOLDEN AGE OF SCIENCE FICTION!

A Hardbound Copy of the July 1939 Edition of **ASTOUNDING**!



Critics mark this issue as the first "great" issue edited by John W. Campbell, Jr. It contains the first published story, "Black Destroyer," by A.E. van Vogt and the first story by Isaac Asimov to be published in **ASTOUNDING**.

This hardbound facsimile of the July 1939 issue also contains an Epilogue in which A.E. van Vogt, Asimov, and Rocklynne comment on their own work, their feelings towards **ASTOUNDING**, and especially their relationships with John W. Campbell, Jr.

This classic collector's item is now only **\$9.95** but act fast, supply is limited. Please send my 1939 **ASTOUNDING** to:

Name _____

Address _____

City _____ State _____ Zip _____

Send check or money order (No COD's) to: Analog, P.O. Box 40, Vernon, NJ 07462
Canadian or Foreign orders add \$5.00. Allow 6-8 weeks for delivery.

M6AD-4

counteract the \$150 million dollar fly-away costs of a Boeing 747-400, for example. Because the NASA space shuttle has a multi-month turnaround time, requires a standing army of 40,000 or more people, and throws away a major part of the launch vehicle on every flight, it's impossible to fly it for less than 10 times the projected cost using an SSTO spaceship. Now, more than 12 years after its first flight, the space shuttle is clearly seen to be an experimental vehicle that

cannot possibly be commercially operated at a profit. However, like an airliner, an SSTO can be designed to be operated profitably.

The Hidden Market

Initially, transportation of cargos to and from orbit won't be the most profitable or largest market.

Most space economists agree several years will pass before the space transportation markets adjust to the introduction of the new spaceships.

THE HIDDEN MARKET

Here's the hidden market for initial SSTO Services. The World is shown in polar projection centered on a hypothetical U.S. Southwest Regional Spaceport. The numbered zones indicate how many *minutes* are required to reach any location in that zone from the Southwest Regional Spaceport at "X." Europe is about 25 minutes away, for example, while Japan requires a flight of only 30 minutes. Australia is between 40 and 50 minutes flying time for an SSTO.

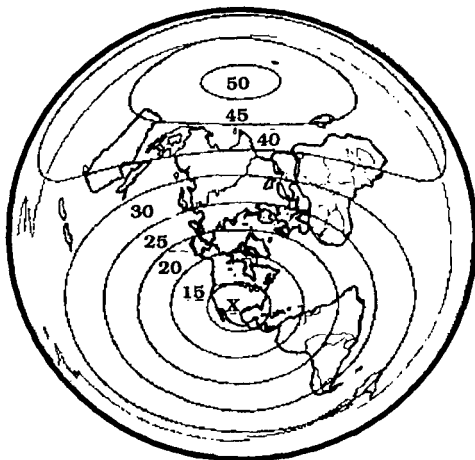


FIGURE 3

While this is happening, however, the new spaceships will have a lot of work to do in another market that's usually overlooked.

Any SSTO spaceship that can take a payload to orbit can also deliver passengers and cargo to any place in the world in less than an hour.

A 15-hour subsonic flight to Tokyo becomes a flight of less than an hour using "Fractional Orbital Transportation"—take off, climb above the atmosphere, make a partial orbit, and come down to land at the destination. Furthermore, it's environmentally benign.

Again, Robert A. Heinlein told us that fast transportation will pay because it always has. Businesses are keen to beat their competition because time is money.

Very well, if operating SSTO spaceships can be a profitable business, thus justifying companies to design and build them, what then? Don't stop here or you'll miss other business opportunities!

The New Spaceports

The new SSTO spaceships will no longer be chained to existing launch sites. A brief look at the historical background will show why.

The original requirements for a site to launch large rockets were stated by Colonel Walter R. Dornberger in Germany in 1935.^{8,9} He was an artillery officer who had been put in charge of the secret German project to develop a long-range artillery rocket with twice the range of the legendary Paris Gun. This rocket became the German V-2.

Dornberger wrote that a rocket launching center should be located on a seacoast because Germany didn't have open land on which these artillery rockets could crash. Since the German rocket program was secret and a lot of rockets blew up in those days, he wanted the facility to be in a remote location for security and safety.

Dornberger described the ultimate firing range for long range artillery.

We're still wedded to Dornberger's requirements because present space launch vehicles were developed from long range ballistic missiles (ICBMs), the descendants of the V-2.

Every space launch center in the world is nothing more than a super artillery range.

When spaceships begin to operate like airplanes, they no longer need to be flown from artillery ranges. They will operate from true spaceports. The new spaceport requirements include:

- Transportation access by rail, highway, and air.
- A "noise-clear" zone extending about ten miles around the takeoff and landing site.
- Clear airspace corridors for departures and arrivals of both vertical-takeoff-vertical-landing (SSTOs) and horizontal-takeoff-horizontal-landing (aerospaceplanes) spaceships.
- Proximity to other transportation nodes—rail, highway, and air.
- Proximity to existing natural gas pipelines; natural gas is a source of hydrogen which can be processed into liquid hydrogen rocket fuel.
- Proximity to a high-capacity

electric power grid.

Note that remote locations are no longer considered necessary.

"But suppose these spaceships fall on our heads?"

People asked the same question about airplanes sixty years ago.

The safety concern of flying spaceships over populated areas disappears with the advent of SSTO spaceships that don't drop boosters or lower stages in flight. They have engine-out capabilities and safe abort modes similar to aircraft. How often does a jet airliner lose all its engines leaving San Francisco International?

The prohibition of flying rockets over populated areas arose on May 29, 1947 when a German V-2 flew off the White Sands range in New Mexico and landed in Ciudad Juarez, Mexico. The present-day flight safety system for ballistic missile and space vehicle launch sites evolved from the policy and procedures developed immediately thereafter by an artillery test officer in the U.S. Army Ordnance Corps, Major Herbert L. Karsch.¹⁰ These require that no rocket or missile be allowed to land beyond the range boundaries.

With SSTO spaceships, such flight restrictions are no longer necessary. The new spaceports will be located where they are needed, just like airports.

The new spaceships and spaceports will require services other than fuel supplies and the facilities for maintenance and repair. Look at any major international airport to get some idea of the services and supporting businesses that will, within

20 years, be clustered around the New Millennium spaceports.

Such spaceports will become the industrial hubs of the twenty-first century hydrogen economy because this is where large-volume liquid hydrogen production and handling facilities will be installed.¹¹

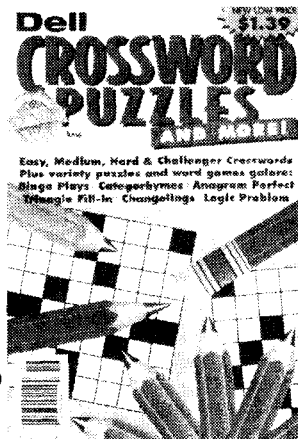
The Legal Issue of Tort Liability

The existence of a large civil SSTO spaceship fleet and extensive, growing spaceship operations also brings up some interesting legal issues. Tort liability is one of these. At this time, if a Northwest 747 airliner has an engine failure leaving Tokyo's Narita International Airport and crashes in the Ginza, the airline itself is responsible under the terms of international law.

However, if any space vehicle has a similar accident in which property is damaged or lives lost, the incident is covered by the United Nations Treaty of Principles. Under the provisions of this early-day space treaty, if a Northwest Spaceline's spaceship has an accident, the company is not liable. The United States government is *individually and severally liable* under the terms of that treaty.¹² Thus the federal government has had to establish the Office of Commercial Space Transportation within the Department of Transportation.

The OCSST regulations covering safety inspections, clearances, permits, and approvals is long and costly for each individual space launch operation, regardless of the type of launch vehicle used. These will become unworkable with frequent

**CLUE: IT WILL
TANTALIZE
AND CHALLENGE
YOU EVERY MONTH**



Each issue is packed with Crossword Puzzles from easy to challenger; Variety Puzzles such as Cross Sums, Anacrostics, Kriss Krosses and much more!

ANSWER:

DELL CROSSWORD PUZZLES

Subscribe today and receive 24 issues for only
\$29.97 or 12 issues for \$15.97



SEND YOUR CHECK OR MONEY ORDER TO:

**DELL MAGAZINES • P.O. BOX 5152
HARLAN, IA 51593**



**OR CALL
TOLL FREE**

1-800-888-6232

Please allow 6-8 weeks for your first issue. Outside U.S. and Poss. add \$3.00 per year.
U.S. funds only.

M6XP-1

SSTO spaceship operations.

Therefore, the United States needs to investigate getting that treaty amended to reflect the reality of the coming age of commercial SSTO spaceship operations. Or the president must revoke the US ratification of that treaty.

Ratifying a treaty requires the advice and consent of the United States Senate. But to revoke one requires only an Executive Order. This happened in the case of the Panama Canal Treaty. It led former Senator Barry M. Goldwater to sue the Carter administration in federal court and lose. Therefore, this set the precedent that the United States can back out of any treaty by a presidential order.

Certification of Airworthiness

Certification of spaceships is yet another issue that must be addressed under international law.

At this time, every airplane that crosses an international border must have a certificate of airworthiness issued by the country of aircraft registry. It must also carry a certificate of manufacture and a cargo manifest.

This has been considerably muddled in the last 20 years because the NASA Space Shuttle orbiters originally didn't carry them. In 1981, an author named Lee Correy wrote a novel entitled *Shuttle Down*¹³ that created a stir at NASA Headquarters. The plot centered around an orbiter that had to make an emergency landing on Easter Island. The Chilean military governor maintained that the orbiter was an airplane that, under international law, had to have a C of A

and other documentation, including passports for the orbiter crew of astronauts and mission specialists. In the early space shuttle program, the orbiters and crews had none of these. Now each orbiter carries all the necessary documentation except a C of A because Federal Aviation Regulations Part 21 has no provisions for certificating a space vehicle.

The legal problem of certification remains unsolved. Again, this will change once commercial SSTO spaceships begin flying to orbit and back. Therefore, some effort needs to be addressed to drafting regulations in this regard.

Definition of Airspace and Orbital Space Boundaries

Yet another legal and operational issue arises over the definition and establishment of boundaries for airspace and orbital space.

No accepted international definition of the interface between airspace and orbital space exists. Thus, the question arises: *Where does airspace end and where does orbital space begin?* Or will it make any difference? Indeed it does, especially from the standpoint of national security.

At the present time, over the United States and most of the rest of the world, controlled airspace as defined in various federal and international rules and laws ends at 60,000 feet above mean sea level. That is as high as the authority of the FAA and other national aeronautical agencies goes when it comes to air traffic control.

Who takes over from there?

That's unknown at this time.

The USAF awards astronaut wings to pilots who have flown above 50 miles, while the Federation Aéronautique Internationale with headquarters in Paris says that space begins at 100 kilometers (62 miles). The Office of Commercial Space Transportation hasn't addressed the problem. It must be resolved in an international conference within 10 years.

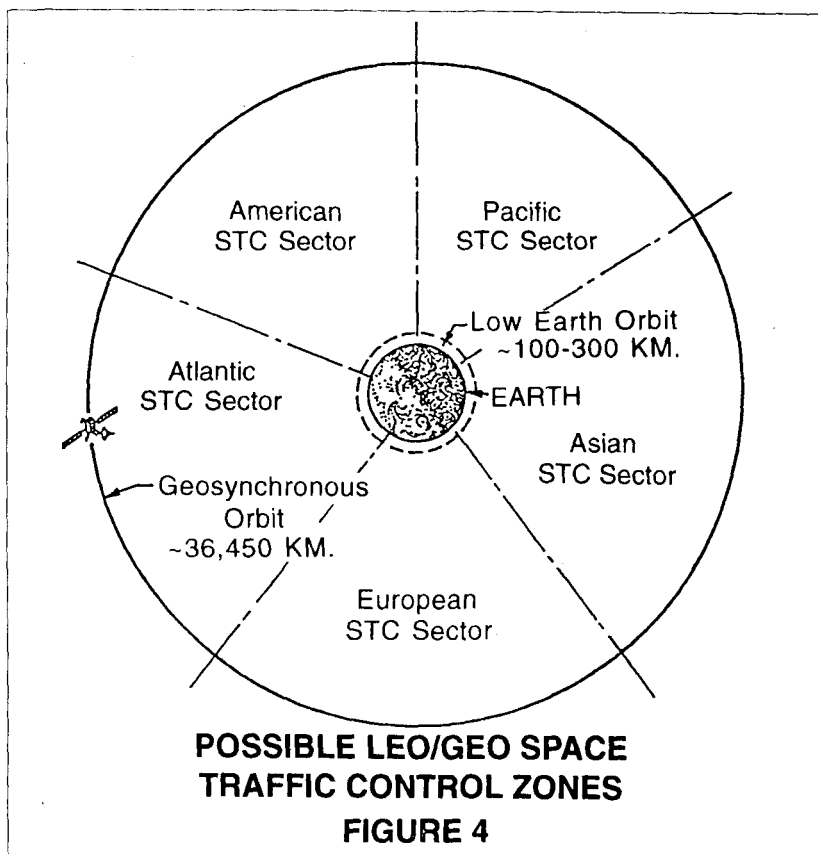
* * *

Space Traffic Control

In the coming era of expanded and extended space operations with SSTO spaceships, space traffic control will be mandatory. It is an absolute necessity from the standpoint of national security (Figure 4).

Today, a nation launching a space vehicle is required to report the launch and the orbital elements to the United Nations after the fact.

This poses a severe problem for na-



tional defense in the future when SSTO spaceships begin operations within and through the atmosphere.

For example, if you're on duty in the national aerospace defense command and detect *something* coming over the horizon at Mach 20, you won't have time to identify it and determine what action to take before it's passed and gone.

Does it have an announced flight plan? Is it the same vehicle that was flown on that flight plan?

Is it the daily FedEx flight from Beijing that took off an hour late or a threat to someone other than UPS?

Do you alert your ballistic missile defense system? Do you shoot or not?

You won't have time to make a telephone call to get more information. You must know in advance. The thing leaving that ionization trail must be squawking the proper code on its radar transponder. If it isn't, you must have rules and procedures to implement *immediately*.

The principles of air traffic control must be extended into orbital space. Space Traffic Control out to geosyn-

chronous orbit and probably beyond will be required. And soon.

Again, science fiction author Lee Correy, wrote a novel, *Manna*—serialized in this magazine—in which space traffic control existed¹⁴. Don't say that science has outpaced science fiction!

Conclusions

Because the technology to create SSTO spaceships exists and can be shown to create a profitable business opportunity, we must assume that such spaceships will be built. The coming commercial space age has many facets that have been overshadowed by the effort to bring SSTO technology to operational status. However, a scenario exists where reusable, reliable, safe, responsive, and economical SSTO spaceships can be built but can't be operated because of political, diplomatic, or military concerns that weren't addressed in concert with technology development. It appears prudent to assume technological success and to address these other factors as quickly as possible.

Acknowledgements

The author expresses appreciation to Paul C. Hans and The Enterprise Institute, Inc. for permission to utilize the results of their space transportation economic model.

References

1. Andrews, Dr. Arlan, "Single Stage to Infinity," *Analog Science Fiction and Fact*, June 1993, Volume CXIII, Number 7.

2. Stine, G. Harry and Hans, Paul

C., "Economic Considerations of Hypersonic Vehicles and Spaceplanes," AIAA-90-5267, AIAA Second International Aerospaceplanes Conference, Orlando, FL, 29-31 October 1990.

3. —, "Air Cargo, 1988 Traffic and Assessment," *Distribution* magazine, February 1989.

4. Stine, G. Harry, *The Third Industrial Revolution*, New York, G. P. Putnam, 1975.

5. —, Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-fifth Congress, Second Session, January 24, 25, 26 1978, U. S. Government Printing Office, Washington, D.C.
6. Stine, G. Harry, *The Space Enterprise*, New York, 1980, Ace Books.
7. *Op.cit.* "Air Cargo, 1988 Traffic and Assessment."
8. Dornberger, Walter R., V-2, 1954, New York, The Viking Press.
9. Stine, G. Harry, *ICBM: The Making of the Weapon That Changed the World*, 1991, New York, Orion Books.
10. *Ibid.*
11. Hans, P. C. and Stine, G. H., "Spaceplane Contributions to the Hydrogen Economy," *International Journal of Hydrogen Energy*, Vol. 16, No. 6, pp 427-431, 1991.
12. "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space," Article 7, 1967.
13. Correy, Lee, *Shuttle Down*, 1981, New York, Ballantine/Del Rey.
14. Correy, Lee, *Manna*, 1983, New York, DAW Books. ■

Nothing astonishes men so much as common sense and plain dealing.

Ralph Waldo Emerson

You gain strength, courage and confidence by every experience in which you really stop to look fear in the face.

Eleanor Roosevelt

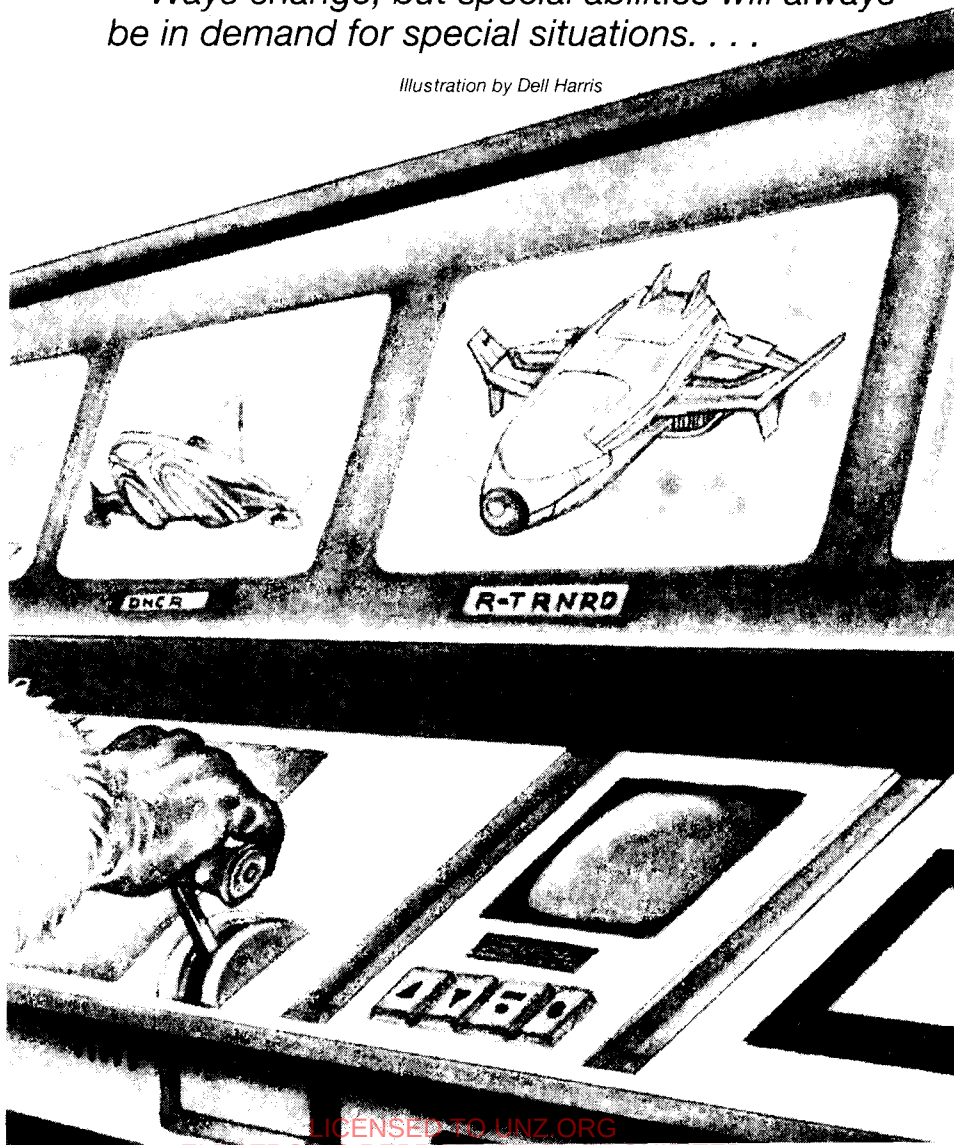


LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Bud Sparhawk **R-TRNRD**

*Ways change, but special abilities will always
be in demand for special situations. . . .*

Illustration by Dell Harris



It was near shift end, the last working hour of a busy and hectic workday. The demands of the new colonies and the ever expanding markets of EXtra-terrestrial Manufacturing And Systems had forced today's human shift supervisor to pay strict attention to the lines for over four hours, reducing his lunch break to a scant two hours! The supervisor looked over the indicators panel for the four hundred assembly lines under his command. He had the help of a few AIs on each line, to be sure, but *he* was the only human involved. He had to make some calls to arrange a few details of his six-day weekend after his strenuous workday, and looked around for the status of the system. There was a minor problem of some sort with the ships being produced on line 263, a logistics issue, it said. Huh, damn AI, always complaining about the stock levels, he thought. Well, let him figure it out. He instructed the AI to handle it any way he could, threw the lines on automatic with an override command to finish the run *without fail*, and turned to the 'phone to make his travel arrangements, wishing he didn't have to work so damn hard to make a buck.

Unfortunately the AI was not very advanced, and took his instructions too literally. One of its rules had been broken cycles earlier, but never detected because it required the stock levels to fall four items below the reorder point. Since another AI always *predicted* the reorder point, stock levels were never affected by the broken rule, that is until now.

Toward the end of the run the

stock of optical units fell below the reorder point by one, by two, by three and there were no more available. On the fourth demand for an optical unit the AI, following its rigid rules, diverted a suitable substitute for installation and posted a resupply order. The line shut down behind the final unit. The run was complete. It awaited instructions from its next human supervisor.

Nick was out in the shed, overseeing the operation of his band of small fabricators as they assembled the units from the parts sent down the cable from the polar station one thousand kilometers above. The foot of the cable was solidly anchored, over five kilometers deep, into the only exposed bedrock on the whole frigid planet. Earth sent small machined parts that the Thule colony couldn't make for themselves and left it to Nick's operation to do the final assembly. The shed was filled with the steady humming of the tiny autonomous fabricators as they worked on the latest task.

L-fing, the chief fabricator and one of Nick's favorites, sounded as angry as one of the small units could get. "Look at this!" it exclaimed, "Do you call that a leg?" It held out a deformed member about twenty-five centimeters long. Nick looked at it carefully. As far as he could tell the leg looked perfectly functional for the small terrain hopper L-fing was holding in its other "hand."

"What's the matter? It looks all right to me," he said.

"All right! It's a B-stroke-9-AF-sub-

2. It should be a B-stroke-9AE sub 2. Do you realize what that means? There'll be a gap of nearly 0.01 mm between the body and the housing. The spec for the hopper reads 0.009 mm!"

In a way Nick regretted ever having the quality control features enabled in the chief fabricator. It had made him unreasonably persnickety. "I'm sure that won't matter to the farmers who get it. After all, it is just a little garden hopper." It hardly required the tight tolerances that L-fing would deem acceptable.

"Just the same. . . ." L-fing began.

At that moment the command channel sputtered into life, "Nick, Settlement Six here. Thought you'd like to know that BNDR has gone down over the Ingla Sea. We're sending a crew to see if we can salvage anything. See if you can whip up some replacement units for us."

The shipment of farm machinery to Settlement Six had cost that group an arm and a leg for fabrication and shipment. Nick's local crew had been hard put to handle the heavy metals and fine crystalline structures necessary for this level of advanced machinery. Oh, the hand tools and crude engines that they could fabricate locally were all right, but to colonize a world you needed intelligent machines, autonomous farms, and a host of technologies that only mature fabricators could provide. For Thule that meant paying the huge fees demanded by the Earthcorps and their horrendous shipment fees for the components. And Nick added his own upkeep to that for assembly and

delivery.

Now BNDR, one of his delivery ships, had reportedly dumped an entire load in the ocean south of her destination—fuel limitation, personal survival mode—the ship had transmitted just before it went down. No way of knowing what had caused it; too damn expensive to get down there to see. Not enough time either. The eternal cloud cover overhead had been dipping lower and lower in these fading days of summer. In two months they would descend and close the cable head down for the duration of Thule's long harsh winter, a time when absolutely no shipments could come down the cable and be distributed around the world.

The delivery ships were the latest advance in technology from Earth, which still produced the finest engineering in the known Universe. They were constructed atom by atom in sintering tanks with their intelligence and controls an organic part of the entire hull. There was no pilot's cab on these ships; they were capable of autonomous control over a wide range of environments with algorithms to handle every known contingency. Each ship was carefully and uniquely constructed for each planet from a wide selection of possible models. Wings and body were aerodynamically optimized for local gravity, pressure, and weather conditions. Optical sensors were tuned to facilitate operation over a wide range of visual conditions. And engines were designed to take advantage of whatever fractions the locals were able to distill or extract.

For the most part they were simply machines, but in another sense they were living entities, each with its own personality and behavior. In-band signaling on standard frequencies provided communications between the ships. Originally this was a channel devised to allow the ships to learn from each other, but as the ships' intelligence grew the channels became a way they could socialize and exchange information about this world they had entered.

Nick listened to the news with some bitterness. To the settlers the ships were just the machinery that brought them their supplies. They didn't know them as Nick did. They didn't realize that each one was an individual, a thinking, living being as much as they. Huh, the settlers even refused to understand the rights of fabricators, thinking of them in the same light as the ships. But then, that's why Nick was isolated up here in the polar regions, tending the cable head, the seagoing ship depot, and the main fabricator operation. He had always had more of an affinity for the machines than he had for adults. Children and machines, those were the two things that Nick understood. As for the rest. . .

BNDR had been one of his original delivery ships, a rare gem of a ship who could relate bills of lading clear back to settlement year four. They had seen a lot of history together, the two of them. He would miss her. He wiped a wet drop from the side of his nose and turned to the door.

Nick tuned to the command channel and confirmed the message. "That

leaves me with eight active units," he said to himself; one tends to do that at these lonely outposts. "That's too close to minimum. I'd better get over to the hangar and get another one out of hibernation." He went to the locker and withdrew his high-visibility red jacket. Even now the chill in the air required some covering.

As he walked the short distance from the fabricator shed to the hangar, he glanced at the surrounding mountains and the low-hanging cloud cover. He hoped that they could get someone to the crash site and recover some parts of the shipment, that is if it wasn't at the bottom of several hundred meters of water. That was the problem with this world—too damn much ice and water and not enough land. Shoot, the single continent, if that was what you'd call the largest of the islands, had just enough mineral reserves to feed their own young fabricator. The rest of the planet was dotted with isolated islands spread over the entire globe, the peaks of vast mountain ranges that were the residuals of early tectonic crashes. The geologists had found nearly one hundred plates sliding and crashing into one another over the face of this world. And most of the mountains were volcanic at one time or another.

The reason, they said, was the eccentric orbit that swung the planet close to its primary, about the same distance as Earth from the Sun, at perihelion, and out around Jupiter during opposition. The result was tidal and thermal stresses that maintained the present island configura-

tion. Since Thule was just emerging from its long "summer" the water levels were at their seasonal high. Very quickly now the planet would cool as it raced away from the Sun, the winter-long planet-wide storms would begin, and the ice would command the world once more. The long, long winter would begin.

But those same processes had developed some of the richest soil and seas in the known Universe. Every island was capable of producing enough food to feed a population of hundreds, far beyond any growth the colony had planned. Thule was to be a peaceful backwater, a farming and fishing colony that could sustain itself and, in the future, offer refuge to ships bound farther outward. But the settlements required tools, and the tools cost dearly. Maybe, he thought, he could get one of the other islands to lend the settlement some of theirs. With that in mind, he bent to the task.

Nick puzzled over the spec sheets for the ship he had chosen to activate. The model number looked all right, although she had a few letters too many it seemed—"R," it said, "TRNRD." Nobody had noticed that she was different from the others when they had emerged from the delivery vehicle to Thule, one of the more recent pioneering colonies along Earth's ever expanding frontier. And in the months that these latest arrivals sat unused in the hangar adjacent to the runway, he had not seen anything that would make him doubt her credentials.

Quickly he ran down the inventory of his other units. He had three heavy

cargo load "D" models; DSHR, DNCR, and DNNR. Then there were the two medium cargo weights "C" models; CMNT and CPD. Then there was the old "B" model BLZN, which was now the last of his original delivery vehicles, and the two special cargo models, a PRCR and a VXN, that they had acquired from an outbound pioneering ship in exchange for their two last "C" models. It had proven to be a good trade, giving them a broad range of delivery options.

The serial number for the RTRNRD ship also agreed with the invoice, but the cost was different. Why, he wondered, was this RTRNRD unit a few hundred credits less than the others in the shipment? Nowhere in the documentation could he find any reasons. It must be sloppy bookkeeping, he concluded, and continued with his task of bringing his reserve ship out of its long hibernation.

The surrounding hangar sprang fuzzily to life, its dull gray coloring gaining increased definition as her sensors came on line. She swiveled her forward sensors from side to side to check the gimbals, and noted the walls and supports. As the seconds passed she gained additional acuity and could detect the ranks of ships on the opposite side of the hangar. A farther swing showed the remaining dormant ships beside her, awaiting their own awakening.

Quickly, following the precepts of her automatic conditioning, she ran through the checklist. Batteries, landing gear, hatch controls, autobalance sensors, flaps, ailerons, and finally the

multitudinous controls for the advanced four phase engine. The latter coughed to life and spit out a dense black cloud of smoke before the engine started running smooth and clean. Finally RTRNRD, satisfied that she was fully operational, tried the command channel.

"All systems checked and confirmed. Please adjust my port side fuel flow to cell ten, check the charger on the aft batteries for corrosion, and look at my optical sensor for dirt on the lenses."

Nick heard the ship's report and acknowledged. It was always a revelation how these ships woke from their long sleep. It was strictly business at first, very much to the point. It was only later, after they had a chance to learn from the others and gain a little experience with him that they started showing their little personality traits and became individuals. Well, he would see how this one worked out. First he had to see about the details she had mentioned. With a heave of his huge belly, the result of the rich diet the colonists provided, he began correcting the problems shown by the test results. The last item was the optical system.

He unhinged the red cover at the nose of the ship and examined the inside for condensation or dirt. Sometimes the technicians weren't as clean and neat as they should be, leaving all sorts of things inside the mechanisms. This time everything was as it should be. He turned to the lenses themselves and gave a start of surprise. "What the devil...?"

Instead of the array of finely pol-

ished curving glass encased in their rubber mounts, he saw a series of flat black plates. Looking closer, he noted that each plate was divided into a fine grating of pyramidal structures. Each plate had a different degree of granularity. He had never seen the like before.

"RTRNRD, describe what you see," he said on his command channel.

"I see a large bulbous object occluding my near vision," the ship replied. Nick, feeling somewhat chagrined, stepped back and swung the nose cover back in place.

"How about now?" he asked again.

"I see a large hangar, several ships at ready status, and two on standby. Outside the hangar doors I see an empty field."

Nick scratched his beard, a great white bush that he had grown out of boredom with the life of a station keeper. Vision seemed to be all right, although how it worked without the normal lenses was more than he could fathom. Oh, well, Earth kept coming up with new things all the time. Maybe this was just an undocumented improvement. With a shrug he looked at his list, making sure that no item had been missed. "Looks like you're in good shape, girl," he said.

"Thank you, Nick," she replied. "Glad to be in service."

Nick smiled. It was rare that one of the newly awakened ships had such manners; he must remember to congratulate Earth for the conditioning. It made him take a shine to this one. With a wave of his hand he alerted the eight other ships and activated the intership channel for RTRNRD.

He would let them educate her about the colony and her role in their enterprise.

RTRNRD ran through the standard aviation tests the next few days with ease, running her engine up to maximum revs and feeling the lift as her wings bit into the crisp fall air. She followed DNNR through the mountain range and out over the seas on a test flight. It felt good to have the wind rushing by and the sea rolling below as she thundered at altitude. Following some unknown signals DNNR led them on a circular course that brought them back to the entrance through the mountains. RTRNRD was determined to learn how that was accomplished. Neither the grim clouds above or the gray sea below gave a clue to their location or bearings. Neither could she detect any magnetic fields. What was she missing?

Her landings were perfect, flaring gracefully to destroy her lift and settling her landing gear gently onto the tarmac with hardly a squeal of rubber. Apparently she had advanced feedback for better control than the older models. There was little resentment over this. In fact, she detected a touch of pride from the D's over the brutal force they could exert on landing.

The first sign of a problem occurred when she was getting ready for her first delivery trip, a short hop down the coast to Settlement Five, Nordic by name. They had cleared the runway and were making the first turn through the passes. "Don't we go to the right here?" she asked, remembering the course that DNNR

had taken her on her training flight.

VXN replied slowly, as if she were exceptionally slow. "No, notice how the green has faded. That means that there'll be stiff winds up ahead from now into winter."

Try as she might RTRNRD couldn't discern any difference between the route taken and the other.

Later, when they were over the open sea, VXN made a sudden course change for no apparent reason. After staying on this heading for some time she made another adjustment. "Why are we changing our course?" RTRNRD asked.

VXN replied, "We've been following that light-colored band in the sea. That's the effluent from the river next to the settlement. It leads right to the settlement." Try as she might on all five frequencies, RTRNRD couldn't find any variation on the surface of the sea below. It appeared to be an undulating carpet of unchanging gray. "What frequency are you using to sense the current?" she finally asked.

VXN made a rude burst of static. "Tune your sensor frequencies to 6×10^{-8} cm. That band contrasts nicely with the darker color of the surrounding sea."

What she heard VXN saying was ridiculous. RTRNRD's upper range was only 1×10^{-1} cm, far from the radiation band VXN described. To make sure she checked her internal diagnostics. Yes, she was right, there was no way that her sensors could possibly be tuned to that range. VXN was feeding her false information, probably one of those tall tales they use to test the newcomers. Well, she wasn't

going to fall for something so obvious. She'd wait and talk to Nick. He'd tell her the truth about this navigation business.

Nick leaned back in his chair and listened to her inquiry about the navigation protocols with some puzzlement. Why hadn't RTRNRD noticed the changing colors of the sea? Could there be something wrong with her visual programming? He decided to check it out, donned his heavy red jacket, and headed out to the hangar.

Hours later he had RTRNRD flying at low altitude over the plains to the east, trying to find some objects he had DNCR drop earlier. He watched the plot as RTRNRD followed DNCR's course, noting which targets she saw and which were invisible. He didn't need an advanced analysis program to tell him that this little ship had a serious problem with its vision. Probably related to those strange lenses in her nose. She couldn't detect the various primary colored paint splotches DNCR had dropped on the ice cap. And any object smaller than his fist seemed to be just as invisible to her.

Now what was going on here? What kind of vision system couldn't detect color? It would be interesting to see the formal analysis.

RTRNRD was sitting in the hangar charging batteries from the bright sunlight and sipping at the high octane to top off her tanks. She noted Nick's approach as he came through the doors by the funny wobble of the

large round portion of his body. Patiently she waited for the portly station keeper to key his command channel.

"Hello, girl," he said. "I'm afraid I've got some unsettling news for you about your vision."

"What is that, Nick?" RTRNRD asked. "Are my lenses dirty again?"

She couldn't see Nick shake his head in despair. "Worse than that, I'm afraid. Somehow they put in a high band radar unit instead of an optical sensor when you were fabricated. From our tests you seem to have a rather limited band of frequencies that you use to 'see.' That explains why you don't know about colors, the yellow stripe for example. It also explains why your acuity is less than it should be. At the frequencies you use you can't see an object smaller than one degree of arc wide."

"What's that mean, Nick? Can you have it fixed to get me operational?"

"I'm afraid not. The forward sensors are an integral part of your fabrication, not a detachable unit we can replace or repair. Ships in your class are more like organic creatures than machines.

"I'm afraid that we'll only be able to use you for strictly local flights, back and forth to the cable head and the storage depot." He shook his head slowly from side to side, "I'm sorry."

Local duty wasn't too bad at first, but the easy life of day trips from hanger to the cable head, storage depot, and back built a barrier between RTRNRD and the others. She could not share while they assailed each

other with stories of their trips out to the far-flung settlements and the sights they had seen. She could only listen as they described the subtle colors of the sea as they sped along, the pale green of the reefs and the cobalt blue of the ocean depths. She tried to understand what they meant by shade and hue. To her the world was one of five shades of gray, not counting the absolute black and white that marked either end of her strange spectrum. Nor did she have anything to add to the conversations. The trip to the cable head was an uneventful undulation of bare hills and smooth plains. The trips to the depot were one and the same, following the mountain passes to the sea and swinging down to the broad shelf where the sea-going ships could take on their cargos. Everything was made of the same endless gray, the monotonous, unchanging gray. And like the plains she started to assume the same shade, a graying of the soul, a soul that could not escape from the role that had been assigned to her. How much she longed to feel the bite of the thin air high above the sea, above the heavy, humid air of the low levels. How she longed to feel the screaming wind tearing at her wings in a high angle dive. And how she wanted to feel the elation of a graceful descent from the stratosphere to the surface, ending in a graceful flareout that placed her gear ever so gently on the landing pad. With regret she turned off the ship-to-ship channels to hide her bitterness from the others, not that they cared one whit.

* * *

The orders were coming in increasing numbers. With the dread force of winter on Thule nearing, the volume of materials coming down the cable had increased enormously. Every settlement wanted to have complete stocks on hand before the cable shut down and Nick's ships stopped flying the routes. Nick was hard put to keep up with the demand. Even L-fing had problems keeping the assembly crew fabricating the finished goods ready for shipment. Even working triple shifts they couldn't fill the orders fast enough.

The first storm of winter came suddenly, two weeks earlier than predicted. The heavy dark clouds boiled with turbulence, rolling with the heavy freezing droplets that would fall as snow and ice should the temperature drop so much as two degrees. It was racing across the polar sea toward the cable head and would hit within twenty-four hours. The second one was scant hours behind, and a third behind that. If this followed the usual routine the storms would not abate until the runway was under four meters of snow and ice. And that would shut them down for the winter.

It had started just one day before the last major shipment for the year was to go out. All eight ships were to be loaded to maximum capacity for dispatch to one of the settlements. The ships would all have to winter over in their destinations.

And what a bounty this final shipment would be: tiny fabricators for the farmholds to lessen their dependence on L-fing's crew; luxury mate-

rials for the houseminders to turn into clothing and fabrics for the homes; and entertainments for the little ones. And in each shipment, Nick placed his own traditional gift, a bag of candy treats for the children of each settlement. They had been made from the special flavors he ordered from Earth at his own expense.

He donned his red coat and pulled the fur at his sleeves and face tightly around him to guard against the winter wind. L-fing had the shipments all ready to be loaded. Inside the ships were the bundles marked for the colonies. The heavy items were tied in shock resistant cord attached directly to the walls of the cargo bay. The smaller supplies were in the cargo containers—some square and squat, others round and tall. Delicate items were contained in hammocklike holders that would swing free in the space above the rest of the cargo, feathered in the air from harm.

In a twinkling L-fing's crew had the loads stored and secured, ready for departure into the night. Only one set was missing from each load, and that was due in from the depot any time now. An hour earlier he had gotten word that there was a snag on the piers and the load was held suspended between the last departing seagoing ship and the dock. Engineers were working on it and would have it loaded into RTRNRD quickly once it was freed.

"Strange storm front," Nick remarked as he stood waiting in the hangar doorway. "Never seen clouds drifting so low before."

"Strange, but not storm. It's fog," L-

fing replied. "Recommend you keep the ships on standby until it dissipates."

"Can't do that," Nick replied. "The settlements are depending on these being there when they wake up tomorrow morning. And the storm might hit us before it goes. We'll just have to chance it." As he spoke the fog suddenly dropped lower, bringing visibility down to a few meters at best. "Damn, the ships'll never find their way through this stuff. I'm afraid we'll have to notify everybody that the ships can't make it. There's going to be a hell of a lot of disappointment over this." With that he started the long process of directing the ships back into their hangar and scheduling L-fing for unloading and storage.

Just then there was the hum of an engine cutting through the night from the direction of the depot. As it passed overhead it slowed, dropped lower in register, and then built again as it came nearer.

"Damn fool RTRNRD!" Nick exclaimed racing out of the hangar. "Fool ship's trying to hot dog it in this soup. She'll crash for sure. No way to see the runway in this fog!"

Nick felt a slice of cold fear go through him. He had grown to like the little ship. She had accepted her limited role with good grace and had performed every task he had set for her. Despite her disability she still strived for grace in flight. Oh yes, he knew how the other ships excluded her from the reports of the ships' social lives, and the barbs they threw at her for her menial cargo chores. But she had never complained or said one

word of it to him. Bless her.

And now she was out there in this blasted night trying to prove something by taking a ridiculous chance that no right minded delivery ship would dare—trying to find the runway in fog so thick that you couldn't see your hand before your face.

The engines now reached a fever pitch and then stopped. Nick could hear the gentle squeal of the landing gear striking the tarmac. Shortly the thud, thud, thud of wheels rolling over the breaks in the runway told of her arrival.

Nick keyed the command channel. "How did you do it?" he demanded. "How did you find your way back in this terrible fog?"

"Yes," the ships chimed in unison on their own channels, "How could you see the runway in this mess?"

RTRNRD sent a puzzled query in reply, "What is fog?" she asked. "The trip was normal, dull and uninteresting. Have I done something wrong?"

Nick suddenly remembered something from his tech school days. The sensors that RTRNRD had on board didn't operate in the visual range. They wouldn't "see" the droplets of water that made up the thick fog because they were too small. The soup that prevented the other ships from their deliveries was completely invisible to her.

With a whoop he grabbed the tiny L-fing and danced a merry jig. "We can make the deliveries after all" he exclaimed. "We'll use RTRNRD as a guide to get the ships out of the fog onto their tracks. By morning every settlement will have their shipment.

We're saved. We're saved!"

Each of the ships joined in the cries. Now they could fulfill their mission. Now the little shuttle ship could do something they could not. Now they could make these deliveries to all the children of the world.

All night RTRNRD labored, leading the ships down the runway and across the straits to the clear air, or so they reported, on the other side. Once they could see something they called the stars, they could proceed without her. It took five reloads of fuel to make all of the trips and left her batteries in a pitiable state. On the last trip back the batteries gave their last gasp of energy and failed. The energy delivered from the engines wasn't sufficient to support her sensors. Within moments she was as blind as the others. She keyed the command channel and notified Nick of her plight. "I'm proceeding on a straight line," she transmitted. "Please listen for me and tell me when I'm near the field."

"You can't land without your sensors," Nick protested. "You'll crash."

"I must try. I have only a little fuel left and would rather crash attempting to complete my mission than just to waste my remaining life flying over the ocean. Listen for my engines. Off."

Nick strained as the dense fog tried to wrap every noise in a blanket of silence. Twice he thought he caught a stray filament of sound that hinted at an engine humming through the night, but each time it faded away until it was a hint of a memory of an imagined sound. The hooded silence

went on and on, deceiving even his sense of time as well as space. It seemed as if hours had passed since the last transmission, but it may have been moments, he couldn't tell.

There! There was a buzz. No, it was a definite hum. Yes, yes! It was the steady hum of her engines cutting through the thick night, slicing a path back home. "I hear you, I hear you!" he yelled onto the command channel. "You're coming closer and closer. You're right on the track." There was no answer but the sound grew steadily louder.

Suddenly Nick realized what she was doing. She was homing on his signal, following his transmissions to get back to him. "Keep on coming, baby. Old Nick wants you in his lap!" he continued to babble as the noise grew closer.

Finally there was the sound of landing gear striking the tarmac followed immediately by the scream of scraping metal. A dull boom came immediately as the ship no doubt pinwheeled over and over, ripping parts of the hull and wings away as it tumbled down the runway. The last of the sounds had not yet faded into the night before Nick was racing toward the remaining part of the body of the

craft, screaming into the command channel as he went, "Report RTRNRD! What is your status? Damn it, let me know if you're still functional. Say something, damn you, say something!"

When he got to the hull he had to admit that survival of the unit was doubtful. Both wings were torn out by their root spars. Where the cargo and tail section attached was a twisted tangle of cables and threads of control lines, all dangling from the jagged edges of the torn hull metal. The red nose cone that covered the optical system, or whatever she had, lay near his feet, strangely undamaged by the horrid crash. Only one side of the main body was intact, the other exhibiting long gashes of torn plating and leaking fluids. Tendrils of smoke rose here and there. Sadly Nick walked the last few meters and place one hand on her side.

"—sntcls?" she said. "Mrr... exms," she stuttered. "... nhppi. Nu. yrs sjkdnf." she muttered. "Did I make it?" she queried.

Nick fell to his knees beside the heroic ship, tears of joy replacing the painful flow of moments before. "Damn right you did, girl. Damn right!" ■

Customer Service or Subscriber Assistance: Please direct all changes of address and subscription questions to: *Analog Science Fiction and Fact*, P.O. Box 5133, Harlan, IA 51593-5133.

IT'S ANLAB TIME AGAIN—PLEASE VOTE!
**Your ballot will be automatically entered in our
drawing for a free one-year subscription!**

Mid-December is our last issue for 1993, and as usual we're asking you to help us via The Analytical Laboratory. Not only will your votes provide tangible rewards for your favorite authors and artist, but your feedback will help guide our selections of what to offer you in the future. Your vote is important!

Look over all your copies of *Analog* dated 1993, or refer to the annual Index which will appear in our January 1994 issue. Pick your *three* favorites in each of the following categories: novella or novelette (a single category, for AnLab purposes), short story, science fact article, and cover. If you're not sure about a piece's category, you'll find it listed in the Table of Contents for the issue in which it appeared, as well as in the Index. List your choices in order of preference (your favorite in each category is #1) on the ballot below, and mail it in. The ballot is intended to make it easier for you to vote, but if you don't want to cut it out, feel free to copy it. We'll tabulate the votes and let you know how they came out.

Please send your votes to:

AnLab, *Analog*, 1540 Broadway, New York, NY 10036.

To be sure your vote counts, please mail it in time to reach us by February 1, 1994.

Thank you very much!

NOVELLAS & NOVELETTES

1. _____
2. _____
3. _____

SHORT STORIES

1. _____
2. _____
3. _____

SCIENCE FACT

1. _____
2. _____
3. _____

COVER

1. _____
2. _____
3. _____

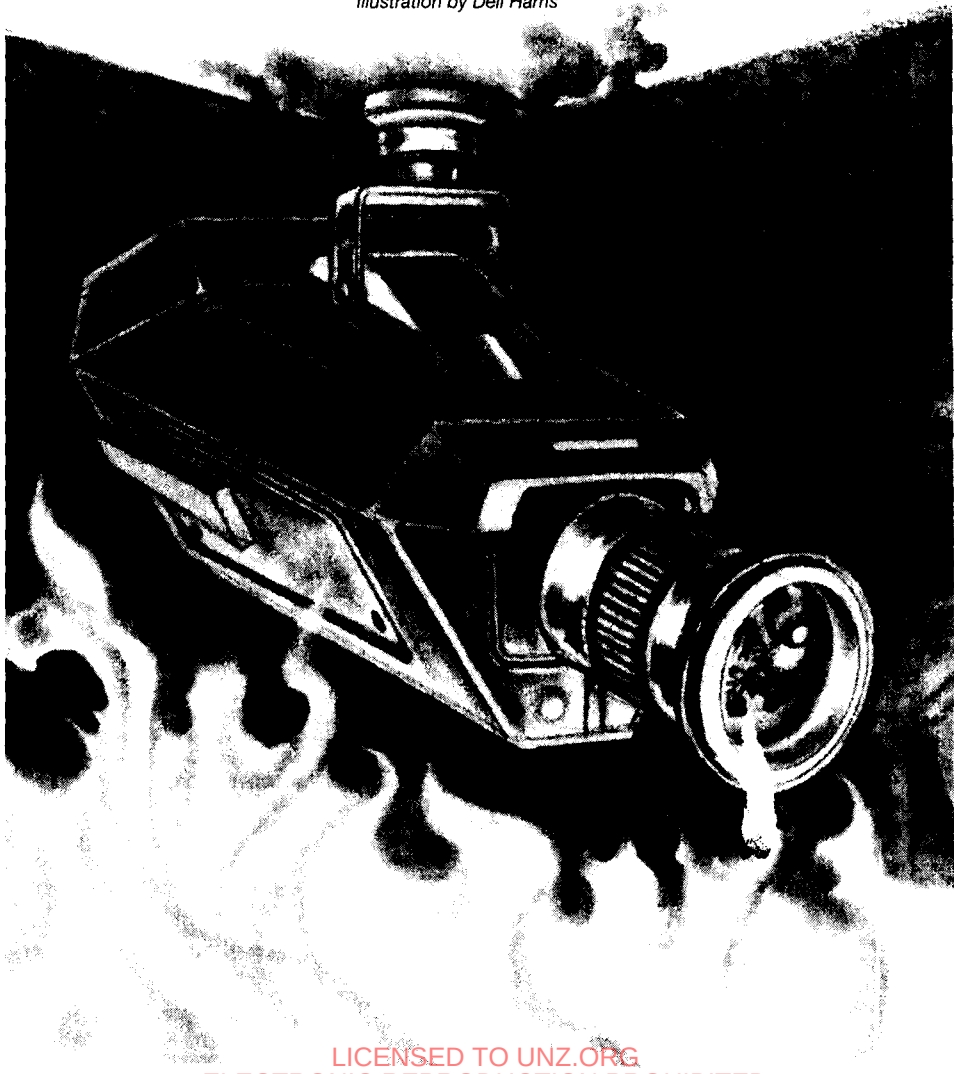
Name _____

Address _____

Mike Moscoe
**ONE PICTURE
IS WORTH. . .**

*Clichés grow from kernels of truth—
but they can also grow obsolete.*

Illustration by Dell Harris





LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED



Manny Domitila fiddled with a pencil as he studied the taller of the two men seated on the other side of his desk. Kenn Wind was the first accused murderer the Public Defenders Office had ever sent him. For all the emotion on his client's face, Manny might as well have been looking at a concrete wall. The shorter man next to Kenn was—Manny checked his file—Steve Berry, Kenn's business partner.

The two stared blankly at Manny. *They're probably waiting for me to do something.* The lawyer swung to face the monitor behind his desk. "Computer, run video in drive B."

The color was poor; surveillance cameras weren't vying for Oscars. A man appeared on the screen lugging two containers. He put one down, then sloshed the other's contents on the floor. Tossing the empty, he doused the second on the floor toward the camera. Attracted by movement, the camera zoomed until the man filled the screen. Finished, he pulled matches from the pocket of his Suncoat, lit one and dropped it. The match went out as it fell. The man stooped, lit two matches and carefully set them in a puddle of liquid. Fire leapt to life. The man recoiled. All around him, flames appeared. The man grabbed the container near him, and fled the room as the camera expanded its focus again.

Dispassionate as a good lawyer, the camera recorded flames leaping up walls, fire rolling back and forth across the room. Smoke clouded the scene. Flames obscured the lens for a moment, then the scene returned.

Finally, the screen went blank.

Manny glanced at his client—still no reaction. Kenn was supposed to be a computer wizard. Manny hoped Kenn had never seen this latest bit of legal software. That would spoil the effect. Swinging his chair around so he could see both the screen and his client, Manny spoke to his computer. "Backtrack to the man." The computer obeyed. The man walked backwards into the room.

"Continue reverse." The figure dutifully committed his crime in reverse.

"Freeze frame." The video criminal stopped, gasoline in mid-spew, face almost front on to the camera.

"Profile individual." Manny ordered.

The man in the Suncoat continued to stoop, but a mannequin now stood straight up beside him. Numbers appeared. HEIGHT: 6' 0", HAIR: BROWN, WEIGHT: 175 LB. CAUCASIAN ABOUT 28 TO 32 YEARS OLD

"Construct facial features," Manny said as he focused on Kenn. On the screen, the mannequin would be growing a face, as good as most mug shots.

"Damn!" The client breathed. "That's me."

Manny watched Kenn carefully, trying to take a measure of his reactions. Shock and dismay were there, almost enough to breathe freshness into the cliché that came next.

"But I didn't do it."

Kenn Wind struggled to get a handle on his gut, his face, his life. This was unreal, like a virtual reality tossed

together by a bad programmer. Yet the full 3-D animation wore his body. Kenn scrubbed at his face—to make sure it was still there as much as to wash away the nausea. Whoever had set that fire had killed a friend of his.

Kenn bolted from his chair. Stooping, nose almost touching the monitor, he studied each pixel, as if his eye could spot a flaw. *I'm losing it. Only a computer could put this puppy together, and only a computer's going to find a glitch. But damn, that profile has me, right down to my birthmark.*

"I'm your lawyer, I'm here to help you." Kenn's court-appointed ally oozed smoothness.

Kenn twisted his head to scowl at his defender. "You wouldn't care if I had killed the Sarge. You don't give a damn about any of this!"

"Now hold it, Kenn, you're not being fair." Steve was out of his chair, standing behind him in a second, his hand working the knotted muscles in Kenn's back. Steve was a good partner—cool temper and good back rubs at two in the morning when the code wouldn't come together.

Kenn let Steve work his back for a minute, then slunk back to his chair. "I'm sorry. It's just I've known the Sarge since I was in college. That neighborhood was his home and he saw to it that people made me at home, too. I'd never hurt him." Kenn paused for a moment before adding what had to be obvious to anyone. "And I'm not stupid enough to commit a crime on camera."

The lawyer nodded curtly and leafed through the police file on his desk. "Whoever lit the fire didn't

think he was on camera. He cut the power to the building first. All the surveillance cameras went dead—except the one on battery backup."

For the first time since the police had handcuffed him, Kenn felt hope. "So whoever set me up knew that and put on the big act in front of that camera!"

"Protect-U's policy is not public knowledge. They keep the list of backed-up cameras in an encrypted database...." Manny pointed out dryly.

"And you think that means something?" Kenn interrupted, shuddering at the naivete.

"Right." Steve pointed at Manny's word processor. "Give Kenn fifteen minutes with your old machine and he'll print you out every policy and database Protect-U has."

"But," the lawyer locked eyes with Kenn, "That is no actor in make-up lighting that fire. That's you."

Kenn flinched, his new hope draining down the sewer. *Damn! He's right. I've got to quit spinning and get a handle on this.*

Kenn slouched in his chair as his lawyer wrote on his yellow pad. "I will find an expert witness to testify that encrypted databases aren't as secure as we laymen believe."

Breathing slowly, Kenn forced himself to think. If this was a computer scenario he was creating, what kind of rules would he have? Where's the pot of gold, the key to release the princess? "What's my motive?" He asked, focusing on his lawyer.

Manny looked up from his pad and gave Kenn a tight nod. "The DA says

business was poor. Your office and studio apartment are in a bad part of town. The recent civil unrest afforded you an opportunity to make some money and move to the suburbs. But you killed a man doing it. The DA considers this an egregious murder and is invoking the new statute for expeditious trial and appeal." Manny's eyes narrowed. "If he has his way, you'll be breathing cyanide exactly 180 days from the moment the old man burned to death."

Kenn's breath went out in one long shudder. He was tired. So tired. He wanted to turn the computer off, take off his eyephones and go to bed. Only this was real. "I didn't do it," he whispered.

Manny put down his pen. "Kenn, I need hard evidence to prove that. Where were you when it happened?"

Kenn glanced at the date/time stamp on the monitor—1342 3/3/99.

Steve turned in his chair. "Yeah, Kenn, normally you'd just be getting up."

Kenn stared at his hands. "I had a problem with an algorithm and couldn't sleep. I went for a walk."

Manny shook his head. "Kenn, a jury will have a tough time believing that. Nobody walks around when the Sun's that dangerous, and there was a riot going on. They were beating up white people like you."

"I had the hood on my Suncoat up. I walked the side streets and there wasn't any rioting there." Kenn shrugged. "I don't know. Maybe there was a riot, and I just didn't notice it."

"When he's concentrating, he can be really out there." Steve offered the

lawyer.

Manny frowned and shook his head. "This isn't helping me or you. I need evidence."

Kenn shivered. This was getting him no place. He clenched his teeth. Where was a hole in the evidence against him? "That video is a lie. Hasn't the DA run any tests on it?"

"Right," Steve sat forward. "Run a seam search. Find the places where the fake breaks into the scene or where the foreground is the wrong focus for the background."

Manny flipped the file open to a red Post-it. "The DA did. There are no seams."

Steve blew a dry whistle. "This guy is good."

Kenn closed his eyes. A knife in the gut would have been more welcome. It kept getting tougher. He was playing this game in real time for his life. If there was no software goof, what did that leave? "Well, he must have patched his video in somewhere. Go back to the beginning."

Manny nodded. "Computer, go to the beginning and start the video."

The screen said 1318 and the room was empty. Kenn shook his head. "No. No, before this."

"That's all we have. Protect-U has the cameras on a continuous loop. They only keep the last thirty minutes of video, then, to save on costs, they write over."

"Hell," Steve snorted. "Kenn could put together an hour video in a weekend. This doesn't tell us anything. What about the cameras that lost power?"

"Their last thirty minutes show

nothing.”

Kenn ran a hand through his hair. *I'm trapped in a dungeon. All the doors are locked and I got no key.* To keep his sanity, he talked himself through the options. “So somebody came up with an hour or so of good video, cleaned up the seams, and faked out the cameras.” Kenn’s eyes got wide as he spotted a third door. “Where did they patch into the line? Steve’s the equipment expert, but even I know there’s got to be some evidence of that.”

Manny pursed his lips as he shook his head. “The DA had a specialist go over the wires outside the building. No evidence of a tap in. The fire people searched the wreckage for video recorders in the wrong place. Again, nothing.”

Steve scowled. “You know an awful lot about the DA’s case.”

“The DA thinks he’s got a solid case. If we don’t plea bargain in the next couple of days, it’s a fast track to the gas chamber.” Manny answered calmly.

Kenn sank back in his chair. “I didn’t do it.” He gnawed his lower lip until he tasted blood. “Steve, one of those new biological computers, carbon based. What would one of them look like after it burned?”

Steve shrugged silently.

Kenn turned to Manny, his life slipping through his fingers. “Those pictures are fakes. Everybody knows you can’t trust pictures.”

The lawyer was not impressed. “My mother used to say a picture’s worth a thousand words. She may not be on the jury, but you can bet others

like her will be.”

Kenn shrank into himself. *I’m locked in a dungeon with no windows, no key, and a poisonous snake I don’t know how to put to sleep.*

“What do we do now?” Steve asked.

Manny rolled a pencil through his fingers. “I’ll try to find anyone who had a financial interest in burning the building or putting Kenn out of circulation. DA says someone wanted to buy the place?”

“Yeah,” Steve answered, “but I don’t remember his name. Do you, Kenn?”

Kenn just stared at them, his mind a blank.

Manny continued. “Kenn, you try to find someone who saw you walking at 1:00 P.M. Wednesday, March third. Beyond that, you two are the computer wizards. You tell me.”

“Can I have the video?” Kenn asked.

The lawyer popped the CD out of his computer. “This is a copy.” The three stood as Manny handed Kenn the disk. “Don’t try to take your release bracelet off. If it beeps, call the number that shows on the display. Some computer will ask you a question. What’s your social security number, your birthday, your street address? Key in the number. It’ll happen twice a day.”

Kenn rubbed the thick plastic bracelet with its radio locator. “I don’t have a home address any more.”

“A lot of clients don’t. Key in three nines. It’ll give you a second question. You can refuse three before they send a police car for you.”

“Why don’t you stay at my place?”

Steve offered. "After making bail, you're broke until our next royalty check. I've got extra computers you can use. You'll need them to analyze that video."

Kenn opened the door for Steve. "Thanks, but as my lawyer just said, I need to find someone who saw me walking."

Outside the lawyer's office, Kenn asked to borrow his secretary's phone. Steve waved as he left, but Kenn was busy dialing Barb's number. It rang several times. Kenn was composing something for her machine when Barb picked up the phone.

"Hello." She made the word glow.

"Barb, it's me."

"I saw you on TV." Her voice went flat.

"It's really been a zoo today."

"How could you?" Her voice rose and broke, shards slashing Kenn.

"Honey, I didn't." The phone clicked before he finished. He was talking to the dial tone.

The lawyer's secretary looked up from his word processor. "It happens to a lot of our clients. It's shock to see someone you know in handcuffs—to know all your friends saw it too. She'll get over it."

Kenn stuffed his hands in his pocket, swallowing a retort. *Where's your counseling license?* The guy was just trying to be nice. "Thanks. Things have been a bit rocky lately. She wants that house and picket fence. I'm not ready for it." *May never be, now.*

The secretary nodded, and Kenn left.

* * *

The squeal of air brakes brought Kenn out of his mind-dead funk.

"Bus route ends here today, folks. You'll have to thumb a ride with the National Guard." The bus driver already seemed bored with his joke. Tired people filed off the bus—dark-skinned people. Kenn was the only white. The bus driver eyed him. "Now's no time to go slummin', kid."

"I'm going home."

The driver shrugged.

His bracelet on one arm, the video disk in the other hand, Kenn tried to recall where he'd walked three days and a million years ago. It was not easy. He refused to start at the burned-out hulk of his home. *Sarge, you survived so many wars. All you got was a home in the ghetto with the rest of the blacks. And somebody burned that down. Who?*

As Kenn wandered up an alley, a dark form stepped out of a doorway. The jacket and hat were gang colors. Kenn halted, stood straighter, ready to be wolf, ready to face down death.

The man studied Ken, then white teeth slowly joined white eyes in a broad grin. "Kennie, my man, what are you doing in my neighborhood?"

"Hunting for someone."

Hampton Brown stepped gingerly over the trash. "Today is not a good day for you to be anywhere around here."

"It's my home, too."

"Yes," Hampton's grin narrowed. Kenn watched as his friend adjusted his coat, concealing but not hiding a machine pistol in easy reach. "But not all the bros know you, and your face

is wrong. Some dumb kid hunting for a bad rep might do you before anyone can tell him wrong."

Kenn held up his wrist. "DA wants to do me, too."

"Lot a people loved the Sarge. Not a good time for you."

"I need to find somebody who saw me walking Wednesday. I need it bad."

"Kennie, nobody saw nothin' Wednesday. Get that straight. Go away. I'll get you out of here."

Kenn wasn't ready to run. Somebody had to believe in him. "Take me to Maria Mendoza's place."

Hampton shrugged. "It's yo neck."

They stayed to the back alleys and side streets. Only once did they cross a four lane road. Hampton studied the situation like a combat vet. "Don't want no NG's. Don't want no store guards taking shots at us neither. Any-one a bullet hit is a looter."

It took an hour to get to Maria's street. "You're on your own from here, bro." Hampton was gone.

Maria Mendoza sat on the front stoop of her small bungalow, watching the sunset.

"Hi, Maria."

She squinted up at him. "I saw you on TV." Her dark eyes settled on the bracelet.

If she hangs up on me, if she sends me into the dark, I won't live until morning. "I loved Sarge, too. I'd no more burn down my home than you would yours."

The moment stretched long. Then she nodded. "Where you staying?"

"No place. I just got out of jail."

"Steven?"

"He offered. His place isn't home."

"Nobody slept on the couch last night. You can have it. Anna, set an extra place for supper," Maria called through the screen door.

Kenn hadn't brought anything. Maria was raising six kids on her own since a liquor store robber put a bullet through her husband's head. A plate of beans for Kenn would make her children's meals smaller still. "I have already eaten," he lied. "It is your computer I need to use. May I?"

"Sí. Tomas is probably doing his homework."

Kenn let himself in, asked Anna for a glass of water, and headed down the hall. He had helped Tomas build a room on the back of the house for himself and Kenn's hand-me-down computer. Tomas was now in his second year of college. Kenn paid him for odd jobs; scholarships never covered everything. Kenn prayed his gifts would help him now. Tomas was playing a computer game.

"Hey, *compadre*, don't you have some studying to do?"

"They closed the college." Then Tomas spotted the bracelet. "They tagged you?"

"Yeah, I need the computer for a while."

"It's yours." Tomas offered his chair, but Kenn needed to stand.

Tomas warm booted the system and accessed the net. Kenn didn't have time tonight to mess with off-site backups; Tomas downloaded commercial graphics and morphing programs direct from on-line, using his own credit. Kenn sat down at the computer only long enough to pull

down some unique programs he had encrypted and squirreled away around the net. The night before the fire he had backed up his latest program to a special cache.

Computer ready, Kenn handed Tomas the incriminating disk. The kid played the video of the arson scene. "Damn, that looks like you," was Tomas's only comment.

Kenn paced, eyes flitting around the room. "Where is that puppy vulnerable?"

"The fire scene looks the most complex," Tomas offered.

"Let's start there."

Tomas ran a commercial program to check for seams as well as luminance and chrominance mapping. "There's not a pixel out of place. The smoke casts the right shadows. You've even got motion blurring as the flames leap. This is the best."

"Maybe too good." Kenn rubbed his chin. "Even digital video shouldn't be that perfect." Kenn stared out the window, seeing nothing. *If it's technically clean, where do we find the glitch?* "Does the fire on the video behave the way fire should?" he asked himself in a whisper.

"I don't know," Tomas shrugged.

Kenn grinned. "Let's find out."

Tomas quickly accessed most of the public domain sources. They didn't help. In a virtual reality, fire was a waving red and yellow thing. That didn't surprise Kenn. *If you want to know the real stuff, go to the pros.* Kenn took over the computer and spent the next fifteen minutes getting into the LA Fire Department's simulator. In another fifteen minutes he'd

learned more about fire behavior than he ever wanted to know. He got out after copying several of their training VRs.

On a hunch, Tomas ran a search program, matching the fire department scenes against Kenn's crime scene. When it finished, he scowled. "There's forty seconds of fire video. Twelve segments are a one-for-one match with the training VRs. No way that's coincidence."

Kenn stared at the screen, his gut nowhere as happy as Tomas's words. "Not one matching section is more than two seconds long. The morphing between segments is perfect, no seam." Kenn scratched his fist. "That's why the DA's software found nothing." Kenn shook his head. What they had here could raise doubts about the video for a jury, but it was no knockout blow. Kenn ran both hands through his hair. "Let's look at the rest of the video."

Tomas ran the video back, then turned loose programs to search for tables that were too level, walls too flat, clothes too wrinkle free.

"It's easy to generate graphics," Kenn whispered as the programs did their work. "It's tough making a graphic as imperfect as the real world."

They found nothing.

"Somebody used a lot of computer time." Tomas looked blankly at the screen. "The polygons in this thing must have been rasterized down at the millimeter scale. There're dimples in the walls where the carpenter hit the nail too hard. The corner doesn't meet at ninety degree angles.

Are you sure all of this is computer generated?" Tomas asked.

"You've got something there. He could have used pictures to save on texture mapping. But shit, it still takes a lot of work to get everything in the right focus."

"The fire. That's one hell of a complex routine. Whoever did this had computing power to burn."

"Yeah, but who'd do this to me?" Kenn stretched, his fingers aching to get around that person's throat.

"The developer who wanted to buy the block. He could've seen the riot as a time to clear everyone out."

Kenn frowned out the window for a long minute. "The developer didn't have anything against me personally. Why would he go to all the effort to incriminate me? Besides, only half the block burned. If that dude was serious, he'd have gotten us all. No. This guy's got something personal against me, and he's good with a computer. Good enough to merge pictures and graphics without a seam."

Kenn circled the room, a tiger in a cage too small. He was going about this all wrong. There had to be a better way. Back to basics. "Where are the mistakes? Every program has mistakes. No. That isn't it. Computers don't make mistakes. People make mistakes. The person who made this video must have made a mistake. And that mistake will be as personal as a fingerprint."

Tomas stared at the screen, eyes glazed. "Mark Pratchett in New York could have done this. Probably Terry Chain in Atlanta. That kid, what's his name, in Hereford, Texas."

"Danny Loc," Kenn provided. "But why would a sixteen-year-old fly out to LA to burn me out? Who around here is this good?" Kenn knew if he answered that, he answered everything.

The phone rang in the house. Kenn was still pacing the floor, looking for a better angle on his problem when Anna appeared at the door. "*Señor* Berry for you," the teenager frowned.

Surprised, Kenn put his question on the back burner and went to answer the phone. Anna followed and stood beside Kenn like a shadow as he talked.

"Yes, Steve."

"I thought I might catch you at Thomas's. You find anyone who saw you?"

"No, nobody saw nothin'." Kenn quoted.

"Kenn, I've been thinking. We really need to go over that video. You and I are the best there is when it comes to the tough ones. Why don't you come over here? I want to help."

Steve's voice carried. Beside him, Anna scowled, as if she'd bitten into a sour chili pepper. And something went off in the back of Kenn's mind.

"Thanks for the offer. But I think I'll pass."

"Hey buddy, I've got plenty of spare computers. You're going to need a lot of CPU time to go over the different chunks of the graphic. With the two of us looking, we're bound to wring a mistake or two out of that VR. If you don't spot it, I will."

How many computers does Steve have? He seems to buy a new one every six months or so. Uncomfort-

able with his partner's solicitousness, Kenn shook his head. "I want to get an early start in the morning talking to people around here. I can't do that if I stay up all night hacking. We'll do that tomorrow."

"Right, pal, anything you say. Good luck." Steve hung up.

Gnawing on a bone he didn't like, Kenn slowly walked back to Tomas and the computer. "Your sister doesn't like Steve."

Tomas shook his head. "He's like too many of the young men she sees on street corners around here, trying to sell you shit."

Kenn chewed on that for a moment. "And you?"

Tomas's face closed down. "He's hungry. He wants everything fast. Like the men on the streets, he'll take short cuts."

Kenn's eyes narrowed. "Steve would love that fire simulation. I have to pry him out of things like that all the time on our VRs. He loves making them perfect, no matter how long it takes. The game companies don't want the simulations great, they want them Tuesday."

Tomas sat at the keyboard, waiting for Kenn to tell him what to do next.

Kenn rested a hand on Tomas's shoulder and shook his head. "If we find a mistake, it may lead us to the programmer who made it. What we've got to do is find that mistake. Everyone makes mistakes."

"What should we look for?"

Kenn made a fist, punched air. "The mistake Steve'd make. He loves the hard stuff, but hates the details. Let's go over the details. I've got a program

that'll help."

The alarm went off. Manny swatted at the snooze bar. Eight o'clock had come way too soon. The noise didn't quit. He opened one eyelid a hair, took a glance at his clock, and grabbed his ringing phone.

"You know what time it is?" He used his most witness-intimidating voice.

"Yeah, three, why?" Kenn Wind answered innocently.

"Because waking your lawyer at three in the morning can get you ten to life in a federal penitentiary! Law-abiding people are *asleep*."

"Well, programmers get their best work done about now."

Manny swore. *Never represent a computer nerd. Contempt of court is better.* "What da ya want?"

"Will you be in your office, say at ten?"

"Yeah."

"I'll be there. I've got something you'll like."

"That's all?"

"Yes."

"Good night." Manny hung up.

At seven o'clock, Kenn let himself out the back door. It had taken all night and the loan of several computers on net to make the second disk that now sat in his pocket beside the first.

As he hiked for the bus stop, the streets were quiet. The air was morning crisp and fresh. A handful of people in singles and pairs headed for the bus and jobs. It was hard to believe he was in a war zone. But the sick

knot in his gut was still there and the Sarge was still dead.

Kenn had too many problems to enjoy the morning. The second disk might show that anyone could create a lying video, but *he*, not someone else, was tied to the crime. *Why the hell would Steve do this to me?*

On the practical level, Kenn needed a better computer than his lawyer's ancient machine for the multi-media presentation he planned. If the owner of the best electronic equipment store in town would loan him some gear, Kenn could at least solve that problem.

As expected, Dave Alasehir was already in the back of his store, though it wouldn't open for an hour. Dave let Kenn in, but his first glance stopped at the bracelet.

Kenn held up his wrist. "It's really the 'in' thing these days."

"Want to tell me about it?"

Kenn didn't, but he ran through the situation as if he were describing someone else's VR game. It still didn't feel real. Kenn finished with a scowl. "How could someone tap into a surveillance camera and not be noticed?"

"For a bank or expensive high rise, they couldn't. A guard would be watching the video output. But a small apartment like yours is something else." Dave shrugged. "The cameras are computer monitored. The computer sees a knife or gun-form, it sounds an alarm. Somebody doing what passes for maintenance work wouldn't trip the program. Even short interruptions of video aren't noticed. They can't call a black-

and-white to cover every alarm. Electricity here ain't that good. Picture has to be down for a couple of minutes before the computer trips a notice for maintenance and a human look see."

"You know a hell of a lot about security systems." Kenn eyed his friend.

"I told you I started out working for the CIA. Maybe now you'll believe an old man's war stories."

Manny needed an expert witness. It looked to Kenn as if he'd found one. "DA says there's no evidence of tampering and the fire inspectors didn't find anything."

Dave sucked on his lips. His eyes went hard, but were quickly hooded by bushy brows. "You said they had six cameras?"

Kenn nodded.

"The fiber-optic cables from those six would have a junction box in the building to feed to the single line carrying the video outside. Most companies order their junction boxes direct. I'm about the only guy in town who carries them. And most of the ones I sell go by the gross to the smaller companies. Don't have single sales too often. I keep track of those."

"You're such a trusting fellow."

"Must have been my gentle upbringing." Dave sat down at a computer terminal and tapped the keys furiously. The store owner smiled as the printer coughed out a sales receipt.

Kenn glanced at it and shrugged. "Doesn't make much sense to me."

"You programmers! You love your toys, but kid, the real fun is taking

the covers off'em and customizing a machine until it does what you didn't think it could. Now, for example, this character paid cash for a single six hole junction box and three expansion cards. Each card had a pair of RS-2320 ports for his fancy new carbon computer. Why would someone want six parallel lead-outs and a six to one junction box?"

Kenn could think of one. He studied the signature. "John Smith. That's a big help."

Dave held the paper up to the light. "Looks like a left-handed signature to me." He put the paper back on the counter and grinned at Kenn. "By somebody who's right handed. Only sold these four weeks ago. Maybe we can remember who bought it."

"You sold it!"

"Nope, guy bought it from a new girl I hired. She's only been here a month."

"Think she'd remember the sale?"

"Your guess is as good as mine. She'll be in at ten."

"Would a picture help?" Kenn asked.

"Whose?"

After ten minutes of computer work, the fax at Kenn's elbow chugged out Steve Berry's driver's license picture. Dave took it and whistled softly. "You two having problems?"

"None that I knew of. Listen, I've got to meet my lawyer at ten. I've put together a multimedia show for him, but his old computer'll choke on it. Could you loan me something?"

"I guess you're in the market."

"I'm also broke."

"I got a new Gamma notebook that can do anything. You'll need a real monitor."

"I was thinking of the thirty inch flat screen you got on display."

"You have an expensive eye, kid. Help me box it."

At ten o'clock sharp, Manny's secretary buzzed him. "Kenn Wind to see you."

Manny grinned at his computer screen. He had something to show Kenn, too. "Send him in."

Kenn was already turning the knob to Manny's office door. Apparently, he didn't pay any more attention to receptionists than he did to clocks.

"Manny, I've got something. Give me a minute to set up." Without waiting for a word from the lawyer, Kenn set a small computer on Manny's desk and pulled a huge flat monitor out of its packing crate. In less than a minute he'd strung wires and plugged it into the tiny computer.

Manny hardly had time to push himself back from his desk before the system was booting up. The lawyer studied the monitor. He had never seen a big screen with such a crisp picture. "Where'd you get that?"

Kenn looked up. "Oh, I borrowed it. If I'm going to jail, I'll return it. If this gets me off, I'm buying it."

"Good deal. What have you got?"

"Watch this." Manny sat back as the programmer played virtuoso on the keyboard and the screen split into four parts. In the upper left hand and lower right hand corners, Manny watched a man dressed in a Suncoat and carrying two metal containers

commit his crime. Only when the figures turned toward the camera did Manny notice that they weren't the same. The lawyer came around his desk and stood three feet away from the screen, studying the two pictures. The new criminal wore Steve Berry's body. But, except for different perpetrators, they were identical.

"You did all this last night?"

"Yeah. Did ya spot the mistake?"

"What mistake?"

Kenn's grin took on a vicious twist at its edges. "Watch carefully."

As the crime began again, the other quarters of the screen came to life in what looked to Manny like a simple floor plan. As the arson progressed, Kenn kept up a running commentary. "This is my latest program. In virtual reality games, people are always putting down swords, sacks of gold, and other stuff. It's easy to keep track of that junk for when they want to look at it or pick it up again. But making sure you have a 3-D rendering of the object in the VR when someone just passes near it is not that simple. Lots of times, if something is just on the edge of the screen, it gets lost. I wrote this housekeeping sub-routine to take the realism in our games up a notch. Steve is great with hardware or programming the tough stuff, but he's sloppy on the little things. I planned to give him this for his birthday."

Kenn's words stopped. Manny turned from the screen to face his client. Kenn was not grinning now. His eyes were deadly cold.

"Watch the next couple of frames. I'll slow it down," Kenn said.

The camera had zoomed in when

both men stooped to drop two matches in a puddle of gasoline. As the men stood, grabbed the second gas can and fled, the camera backed off its focus. Most of the room was again in the picture. As both figures fled, the floor plan next to one of the pictures flashed for a second.

"Go over that slower," Manny ordered; he was having a hard time keeping a rein on his excitement.

The two figures stood, a matching look of surprise on their faces. Over Steve Berry's shoulder, Manny could see the second gas can. On the floor plan of the other, a rectangle flashed red. As the men fled the scene, the flashing stopped. The second gas can was in both pictures now.

Kenn assessed the simulation with a shake of his head. "Steve didn't miss much. He must have figured the can was behind the figure's head and he could get away with skipping it."

Manny tapped the section of screen showing the new simulation. "You put that together last night?"

"Right. Four of my buddies on net weren't using much of their computers' processors so I ran my programs in batch behind them. I kept the COMO files to show exactly how I did it, and when. And by the way, you won't find a seam in my video either. Had to run the test software twice to catch places that slipped by me. But if your DA uses the off-the-shelf software I think he uses, he's not going to find a thing."

Kenn flopped into a chair with a sigh. "I did modify that software a bit, upped its sensitivity. I think I spotted three weak points. I can name you a

couple of expert witnesses who could do their own testing.”

“You’ve had a busy night.” Manny took his own chair.

Kenn rubbed his eyes. “What I can’t figure out is why Steve would do this? I mean, we’re not rolling in money, but we’re having fun.”

Manny put his feet up on his desk. Now it was his turn. “You remember an algorithm you developed a few years back to calculate critical hits on a dragon’s scaled armor?”

Kenn laughed. “Yeah. I was new then and wasted way too much time on it. Was a hell of a job blending different textures: steel plate, bone, flesh, steam-generating lungs. I improved a matrix from a geothermal exploration program I stumbled across. Why?”

“You actually started from geothermal.”

“Yeah.”

“Well, your program does a great job of finding geothermal power sources.”

Kenn nodded. “So I heard, but I was damned if I was going to help people punch holes where they don’t belong.”

“And Steve?”

“He was for taking the money and running. We had a bit of a disagreement.”

“Well, GeoSearch, Inc. last year got federal leases on some California and Oregon land. Their first drill hole came up hot. Guess who one of their major stock holders is?”

“That bastard!”

“On a fast track to the gas chamber, you wouldn’t notice who was using

your program.” Manny finished.

Kenn stretched in his chair, paused, and stared at the ceiling for a long minute. When he sat up straight, his voice was deadly calm. “OK. I’ve found the capability, and a technical fingerprint. You’ve found a motive. Now we need to tie Steve to the scene of the crime.”

“Right,” Manny nodded.

Kenn pulled a small plastic object out of his pocket and tossed it to the lawyer. “That’s a junction box. There were six cameras in my building. The supplier who loaned me the computer recently sold a single six junction box and the computer ports for six fiber optical cables for a new biological computer. Steve recently bought us a small one with a very large flash storage.”

Next Kenn handed over a business card with a receipt attached. “You’ll want to call Dave. The girl who sold that junction box was due in at ten.”

Manny dialed the number.

“Dave’s Electrical Supplies. If you want it hot, we’ve got the charge for you. Dave talking at you.”

“This is Manny Domitila, Kenn Wind’s lawyer.”

“I figured you’d be calling about now. Cindy’s seen the photo. She says that’s the man who bought the stuff.”

“Photo?” Manny eyed Kenn, but he gazed innocently out the window.

“Yeah, Kenn gave me a copy of Steve Berry’s driver’s license photo. Cindy says he’s the man who bought the junction box.”

Manny scanned the sales receipt.

“That was three weeks ago. Don’t you have much business?” Manny had

learned early to cross-examine his own witnesses.

"I asked her. She's new and had trouble finding the merchandise. The guy knew exactly what he wanted, but didn't hang around while she hunted for them. Seemed to want to stay out of sight. I'd warned her the day she started that all our customers weren't good boy scouts. She filed his face away."

It's nice talking to a pro. "They didn't find any evidence that the surveillance system had been tampered with," Manny went on.

"After Kenn left, I called a buddy of mine at the Underwriter's Lab and asked him if his folks had burned any of those biological computers in tests. They had, but were keeping the results off line in archives. He doesn't trust computer security. He faxed me a copy of the lab's results. You want it?"

"Yes."

"It'll start coming out of your fax right about now."

Beside Manny, his machine began humming. Kenn brought the fax to him a page at a time.

Manny frowned. "I'm no chemist, but it doesn't look like much is left."

"And there's even less residue a week later. However, I've looked up the receipt for Steve's carbon computer. What do you want to bet me he

has trouble producing it for a search warrant?"

I definitely like this guy. "I'll get an appointment with the DA. Can I drop by for a taped statement from your employee?"

"No problem. Always glad to help the law get it right."

Grinning, Manny hung up, then speed dialed the DA. While the phone rang, he laughed. "I love it when one of their open and shut cases won't stay closed. Stick around, Kenn. With luck, you won't pay rent on that bracelet today."

Kenn collapsed into a chair as Manny rush out of his office. Kenn knew he should be feeling something—excitement, joy, vindication. Instead, he sat exhausted—flattened by a lead cloud that wouldn't go away. His fingers played with the release bracelet. Maybe when it came off the weight would leave him.

He twirled the bracelet around his wrist, round and round, going nowhere. He had his life back. He was not a criminal. But things would never be the same. Sarge was gone. His home was gone. So was Steve.

The lawyer's phone beeped. Someone answered it.

Kenn ought to call Barb—tell her the good news. He sat. Life would never be the same. ■

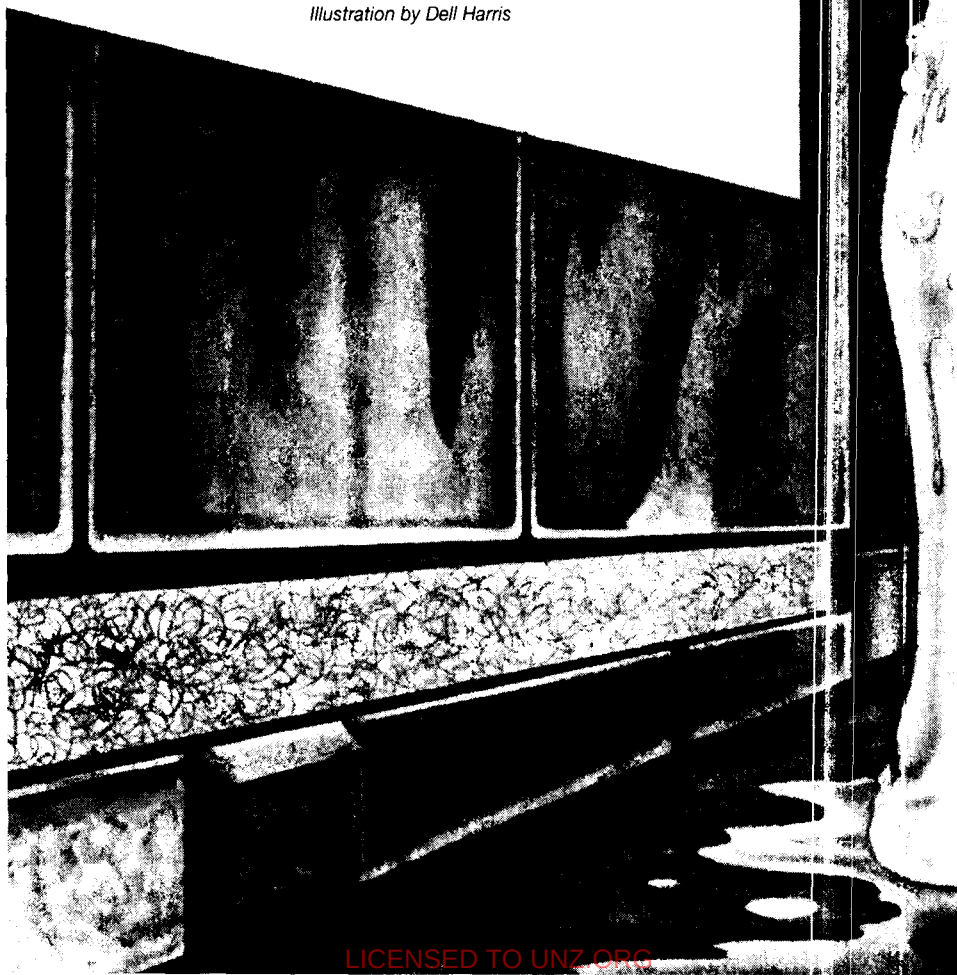
MOVING? If you want your subscription to *Analog* to keep up with you, send both your old address and your new one (and the zip codes for both, please!) to our subscription department; Box 5133, Harlan, IA 51593-5133.

Paula Robinson

PIBLOKTOQ

*New ways of life tend to bring
dismaying new problems. But
are they really new?*

Illustration by Dell Harris





LICENSED TO LINZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"What the *hell*?"

Psychologist Morgan Diersing ruffled his thinning white hair, which looked fuller in the Moon's low gravity. His full brows rose, then fell to shadow his pale blue eyes. He turned to direct a questioning gaze at the dark-skinned woman behind him in the narrow metal corridor.

The loud guttural howl that had sparked his question echoed away. A moment later it was followed by garbled words and loud crying.

"Is that a *man*?" Diersing asked.

Director Myrna Lewis, who wished the good doctor's visit to Moonbase Friendship could have begun on a more auspicious note, closed her eyes and inhaled tightly.

When she opened her eyes again, the doctor was staring at her. It occurred to her that she probably looked like a dinner host whose cat was barfing under the table.

Unexpectedly, and against her will, she found herself giggling. She had to admit, the comparison was funny. And apt.

The older man turned away to stare toward the far end of the hall. Briefly, he batted at an inset on his multi-pocketed jumpsuit, as if making sure something hadn't fallen out of it.

Lewis cleared her throat and shuffled her feet. Her facial muscles tugged to erase her grin. "Yes, Dr. Diersing. It sounds like a man, this time. I think," she said.

Diersing looked back toward her. She was surprised—relieved—to see that he was smiling, even chuckling a little. She broke into a thankful grin.

"You can call me Morgan if you

want," he said, and shook her hands as if he hadn't noticed anything wrong. "Although some people insist on calling me *Doctor* Diersing, now that I'm an old fud."

"Oh." She laughed nervously. "Welcome to Friendship, Dr. Diersing. I mean, Dr. Morgan, ah—"

Her face felt hot. She silently thanked the African branch of her family for hiding the Irish side's tendency to blush. Morgan Diersing had come all the way from Armstrong Base in Mare Marinarus because of her report that some of the staff were having emotional problems.

The fact was, *all* of her staff were having emotional problems. Friendship Base had originally been staffed with a crew of sixty. Various snafus and funding problems had reduced the living area to one-fourth normal, and now resources to keep even that much running were getting scarce.

After all, the taxpayers back home didn't like to spend money on Moon installations that kept breaking down and goofing up. And besides, didn't they need the money more back home on Earth?

Which was why her staff were getting frayed, as the expression went, around the edges.

Diersing looked ready to ask a question when another, louder howl cut him short. Seconds later the source of the commotion appeared, soaking wet and buck naked, at the narrow corner of the corridor.

Seeing Diersing, the pale young man screamed something about somebody else's hair on his soap. He held up the offending bar and, eyes

burning with desperation, cried, "You can't even get a clean bar of soap!" He sobbed. "Even the soap's not private here!"

With that, he seemed to calm. "All I wanted was clean soap," he wailed, and turned to stomp back the way he'd come. "Is that so much to ask for? Clean soap?"

With the man's footsteps pounding away, Myrna looked at Morgan. "That," she said politely, "was what I wanted to talk to you about."

Diersing gave her a long stare. "I can see *why*," he finally said.

"Let's talk in my office. People can hear every word when you talk in the hallways."

Diersing nodded, took a few steps, and stopped. He pointed back at the corner.

"How often . . .?"

Director Lewis squinted, searching her memory. "Four times this month. No. Five, counting that guy."

"Most of them are men," she explained, handing Diersing an insulated pouch of coffee, "although one was female."

The doctor nodded thoughtfully. He folded down the chair, if one could rightfully call it that, set in the tiny office's wall.

"Thanks." He took a long, slow sip from the thin straw. "Ugh. I hope they get real coffee up here soon."

"One of the guys mail-ordered some. Nearly gave the company seizures." Lewis half-smiled behind her microdesk, which also had folded out of the wall. "They had a gimmick where they refunded the cost of cof-

fee if the customer didn't receive it within three days."

Diersing chuckled.

Lewis steeped her hands. "Believe it or nay, the company actually got NASA to promise to send some up in next year's unmanned supply pod."

"Amen to that." Diersing sipped again, and scowled. "At least they're willing to send us *something*."

Lewis relaxed a little.

In the hall, on the other side of thin metal, a recruit sneezed. Twice.

"Not that there's much room to put things." Diersing surveyed the too-close, too-thin walls, and shook his head. "So your staff members run through the halls screaming several times a month?"

"A few." Lewis nodded. She slipped out of the microdesk and paced the two short steps to the window. It covered the entire outer office wall—about the size of a full-size mattress. It was the envy of the base.

"We don't know what the fuh—uh—heck, is going on." She stared at the distant edge of the crater dominating the view. "It's happened at least once a week. The—what? Victims?—test normal when they calm down."

"How do you treat them?"

"What can we do? It's obviously not a physical imbalance, and with the stress here. . . ." She sighed and smiled wanly. "We usually let them go back to work after they calm down."

Diersing nodded. "But how do you deal with the psychological aspect?"

"We ignore it."

"Really."

"We can't spare the labor, and we didn't know what else to do. That's why we called you."

He nodded again. "Why do you think this is happening?" He asked levelly.

Lewis rubbed the back of her neck and stared outside. "I think there are too many people in too little space."

Diersing laughed explosively. "Now there's an understatement!"

She glanced at him and smiled sadly, then returned to staring outside. "We were supposed to get an OK for building additions from the UN, but then there were the African famines and the epidemic in Asia. And all the little wars in Europe. So we're stuck with our present facility, and they say they can't afford to shuttle any of us back home." Without realizing it, she had tensed. Her hands had balled into fists. She was surprised at the tone her voice was taking. "And my base is too damn *small*!"

There was a pause. Lewis glanced at Diersing. She was getting progressively more embarrassed by her lack of self-control.

"How many people are on this base?" He asked.

"About sixty."

"About?"

"Sixty-five. With one on the way."

Diersing nodded. Pregnancies weren't supposed to happen on Moonbases, but occasionally. . . .

"Reported?" He asked.

Lewis scoffed. "Only unofficially. The med staff at Armstrong know about it, of course, but nobody else. We don't mention it on any of the big radios."

She turned away from the window and tried to pace, but was stopped before her third step by the metal wall. Clenching her fists irritably, she faced Diersing again. "We know better than to send Earth anything but good news. If they knew that people on those wasteful Moonbases were making babies—well, you can just imagine."

She stood as if not knowing what to do with her fists, which she then unclenched. Without looking at the psychologist, she slipped behind her microdesk again. She half-braced, half-shaded her forehead with her fingers.

When she spoke, her voice was edged with exhaustion. "The baby's grandmother doesn't even know about it."

There was a pause, broken moments later by sounds in the hallway, where a female staff member bumped the thin wall. She cursed viciously.

The psychologist's brows rose again. When the woman passed out of hearing range, he whispered, "I think she burnt three layers of paint off, out there."

Lewis looked up, and laughed.

"Don't be embarrassed," he told her. "You're in better shape than most of the directors up here."

She blinked, still half smiling. "Oh, God. You are kidding."

He rolled his eyes to stare at the low ceiling. "I wish I were. You should have seen what Mo Singh Base was like when I visited there." He paused, listening to be sure there were no eavesdroppers in the hall. Then he leaned toward her, his tone

confidential. "I never saw so many black eyes. Seemed like half the base claimed to have walked into walls or bumped tables."

Lewis met his stare. She looked confused for a moment. "Are you telling me you think—"

He cut her off. "Moonbase Friendship is doing fine. I'd even say you're doing exceptionally well."

"With people running naked in the halls, screaming, you say we're doing fine?"

Now it was Diersing's turn to look out the window.

"The Eskimos had to live in pretty tight quarters much of the time. They were cooped up in igloos, six or seven to the bed sometimes, for months. Outside, there was nothing but an endless barren landscape, and inside only wall-to-wall breathing bodies."

Lewis huffed. "Sounds familiar."

He glanced back at her, nodding. "Do you know how they coped with the stress?"

She shook her head.

"*Pibloktoq*."

"Hunh?"

"*Pibloktoq*. Arctic Hysteria." He looked back to the landscape. "After months crammed in with half a dozen others, an Eskimo would jump up and bolt outside into the snow, naked and raving. After a while out there he'd calm down, and then go back inside." He looked away from the window, smiling to her. "And the other Eskimos would pretend nothing had happened. Sound familiar?"

Director Lewis frowned. "You think my crew is going hysterical?"

"No. Not in the sense you're thinking about. Actually, I think they're coping with unreasonable stress in a very reasonable manner, just as the Eskimos did."

She laughed dryly. "Of course. Why, running naked and yelling about hairy soap certainly sounds reasonable to me."

"It is when you consider the alternative."

She paused for a moment.

His tone became gentle. "People don't get black eyes from running into walls, Myrna. Especially not at one-sixth normal gravity."

He paused to let that sink in, again staring off into the lunar horizon. A Moon buggy crawled along the far edge of the crater.

Lewis stood and rubbed her arms, as if the muscles hurt.

"I'm going to tell you something, Director," Diersing said. "It's going to upset you, but it's the truth, and it's also going to help you."

She nodded and sat again, rubbing her eyes. "OK. Go on."

"As I'm sure you remember, the incident at Galileo base was what made taxpayers back home wonder whether we really 'needed' bases on the Moon."

Lewis grimaced. The Galileo incident had happened almost four years ago. It had involved two staffers who made an unauthorized trip through an airlock—sans suits.

"The media made sure everybody with a TV knew about the deaths," Diersing continued, "and I mean in sterling detail. It didn't take people long to decide that the Moon wasn't

a good place for people. Our funding reflects that attitude. It explains why we're in such a claustrophobic mess."

Lewis gave him a weary look, but with a touch of irritation.

Diersing held up a placating hand. "You already know the history, Myrna; I realize that. I'm just recapping to it make a point."

"Please do." She didn't intend to sound so sharp. "Sorry," she added.

"I understand, believe me. As I said, you're doing better than most of the other base directors."

Here he paused, squinting at some real or imagined obstacle on the lunar horizon.

"My point," he said, "is that, ready or not, we're on our own."

They paused.

"I'm not sure what you mean," she said.

He didn't seem to have heard her. "If you think about it, it really is a good break for us. We'll have autonomy. Armstrong Base has more than enough plant varieties in its lab to help the other bases establish strong, healthy greenhouses. The only reason that hadn't already happened was because the UN wouldn't—"

She held up a hand, gesturing for him to stop. "Are you saying Earth has released us?"

"Well—"

"Or are you talking about a revolution?"

"I'm—" He paused, thinking. His eyes rested on the closed door. "I'm not sure about that. But I *am* sure that we have to do something before tension and anxiety eat us alive.

"Things are getting out of control,

and fast. So far there have been six homicides, and one serious injury, because the population pressure has been so intense. And you won't hear about them in the news, either. We don't dare let the Earthside media know. There are a few critical supply launches in the next two weeks, and we can't afford to let the governments refuse to send them.

"Now, as for declaring our autonomy..." He sighed, his eyes now meeting hers. "I'm not just suggesting it on my own. Several of the other bases have joined together. *It's already underway, Myrna.*"

He didn't wait for her to comment. "I don't know whether we're being deprived of living space and material shipments because they want to get rid of us, or because they think they can't afford them, or even if they just don't care. It really doesn't matter."

He stood. Claspings his hands behind him, he once again studied the crater. "Either way, we have to start taking care of ourselves. It's that simple."

"And that complex," Lewis said quietly. However, some of the tension lines seemed to have left her face. Her voice sped up. "We're barely scraping by. And there are so many different bases—so many different cultures. I mean, we don't even speak the same languages. How are we supposed to form a government—"

—"We will because we have to."

"But what if Earth fights it? They could send a nuke up here, or worse."

"Why would they bother sending something that dangerous to launch? Especially when they don't want to

spend money on us to begin with.” He smiled smugly. “Besides, you can’t trade for low-gee products with a smoking crater.”

Diersing retrieved a small roll of documents from a pocket near his shoulder. He threw it to her. It rose and fell easily in the low lunar gravity.

As she unrolled the papers and began to read, another staffer bumped the office’s outer wall. The metallic echo reverberated through the narrow corridor.

Director Lewis read the documents carefully. A few minutes later she put them down delicately, almost as if they would break.

When she spoke, her tone was more focused and purposeful than it had been since Diersing arrived.

“It’s dangerous,” she said.

He nodded. “That’s why you haven’t heard about it on the computer nets. Hard copy only. The main question is, is the alternative worse? I say yes.”

She was shaking her head. “I’m not sure how my crew will react to the idea.” But she smiled, her tension lessening. She began to tap two fingers playfully on the tiny desktop. “Still, when they hear about the chance to dig out a couple of dozen extra rooms . . .”

Diersing smiled, relieved to see that he had won her over. “We already have mining equipment from the Japanese base,” he said. Enthusiasm sped his words. “And several other bases have offered to share

products and services. Once we’re free of Earth-based governmental constraints, we’ll be able to expand and link the bases, and from there all we’ll have to do is . . . ah . . . what are you doing?”

She glanced over from the computer screen she had folded up from the desktop. “I’m sorry. It’s just that I have to figure out which way to expand the base, and how much. What do you think? Twenty extra rooms?”

Diersing didn’t have time to answer. Another voice, female this time, was cursing and screaming its way into their corridor.

Concerned, Lewis got up and went to the door. The voice grew louder as she opened it.

Moments later, a nude woman appeared in the doorway.

“All I wanted was a half-hour nap,” the woman said, her face bright with exertion. “So do you think they let me have one? Noooo, they had to play cards—*cards!* And on my bunk! Can you believe that? Right on *my bunk!* Those—” she filled the air with expletives, “couldn’t even wait until I got up—”

Lewis smiled sweetly. “Carry on,” she said, and gently closed the door.

Turning to meet Diersing’s eyes, she said, “Forty.”

“Eh?”

“Extra rooms,” she said lightly. “Make it forty.”

Diersing blinked. Then a slow, close-lipped smile spread across his features, and he nodded. ■

Paula Robinson is knowledgeable about biology. Most science fiction writers and readers tend to be more familiar with physics, mathematics, chemistry, and especially engineering. Aside from doctors who write SF, only a handful of authors make biological sciences central to a story.

An outstanding exception is Paula Robinson, who became self-educated in medicine by trying to understand what has been threatening her since childhood. Paula's first major published piece was in the spring, 1977 *Diabetes Forecast*. She dealt humorously with the public's misconceptions about juvenile diabetes. Suffice it to say that internal organs, and even eyesight, are badly affected by misadjusted metabolism. Only the development of human-type insulin has given any hope for long-term amelioration. Paula follows the latest research, especially the possibilities for genetic repair.

A passion for knowing things pitted her against the guardians of the keys to knowledge. She fought to study physical anthropology at the graduate level while studying English as an undergraduate. Early on, she became interested in finding out where man came from, and trying to figure out

where he is headed. She originated in California, then was moved to Cincinnati when she was a few years old. She attended the University of Cincinnati, and earned a B.A. in English. She also insisted on taking courses in an assortment of sciences, mystifying and even scandalizing educators by doing so.

Like other writers, Paula has had mind-numbing jobs—secretary, cleaning up a lake, data entry, cashier, typesetting, and fast-food shoveling. Working as a clairvoyant must be

(Biolog continued on page 159)



THE MOON PYRAMID

Warning: Space advocates may not like what they read here this month.

NASA officials have publicly stated (I was there and heard it) that we cannot get back to the Moon within ten years. Never mind that we did it the first time in eight years, starting from scratch with no prior experience.

It looks like Space Station Freedom is dead. It may have been killed in the annual budget process after this is written. Freedom has been cut back to Fred, then canceled (F-Stop), then reactivated (Dum), and is now being redesigned into something else. It may continue as a high-tech jobs program.

The question is being asked, "Why do we need a space station?" Shucks, I thought that one had been answered back in the 1920s. Or even by Tsiolkovski early in this century.

We once had a perfectly good space station. It was called "SkyLab." We let it die over Australia. The Russians have put up eight space stations and still have at least one working space station in orbit as this is written. They have offered to sell a brand-

new, fresh, never-used *Mir* for about \$25 million plus change. And they have the expendable boosters to place it in orbit.

The Russians have a space shuttle, too. It's flown unmanned once. Now, with the end of the Cold War and no further need of a space program for their national security, they've got several orbiters and at least seven *Energia* boosters sitting around at Tyuratam in the open, covered with torn polyethylene sheeting.

The NASA space shuttle is wearing out. It costs more than \$1.2 billion per flight. It operates at the whim of the weather. It takes six months to refurbish an orbiter for flight. The engines are removed and sent back to Canoga Park to be completely rebuilt, then to Mississippi to be completely retested, and then to the Cape where spare ship sets sit around for months in case other used, rebuilt, retested engines have to be replaced in an orbiter. The on-board computers have less computing power than the PC on which this is being written. NASA is flying a Lindbergh "Spirit of St. Louis" in a 707 world. Yes, the time between the Ryan NYP of 1927 and the Boeing

387-80 jet airliner prototype is the same that has passed since the basic space shuttle technology was developed. Placed in the perspective of aviation history, we aren't doing very well in astronautics, are we?

Many of us are pinning our hopes on the McDonnell Douglas Delta Clipper Single-Stage-To-Orbit spaceship. It could be flying 10 tons to orbit daily by the end of this decade. Analyses indicate that it can be a commercial success. But, as of this writing, the one-third-scale DC-X prototype hasn't flown yet, and the DC-X is a Single-Stage-To-20,000-Foot rocket. The Lockheed Skunk Works has pitched another SSTO proposal in Washington, and three other aerospace companies have SSTO designs in the files. However, the federal government—NASA and the USAF—seem to be enamored with something called NLS (otherwise known as the “Never Launch System”) that will generate tons of paperwork and studies on how to build a very expensive new expendable launch rocket system by the year 2010.

Given this pessimistic view of astronautics in general, one must legitimately ask the nasty question:

Are we backing away from space? A challenge? A new frontier?

Maybe. Similar things have happened before in other cultures.

We know that the Norse undertook a major effort to colonize Iceland and Greenland from 860 A.D. onward. The drivers for this were overpopulation, lust for glory and adventure, and dissatisfaction with the political situation in Scandinavia. Royal domains

finally had been established there, prompting the freedom-loving warlike nobles to migrate. They got as far as North America in about 1000 A.D. but simply couldn't maintain a Vinland outpost. After two or three years, perhaps in a place called L'Anse aux Meadows in northern Newfoundland, they pulled out. The wilderness there was formidable and the natives quite hostile. The Norse venture seemed doomed from the start. Although the climate was a little warmer then, the Greenland colony was barely viable and required constant support from Iceland. By the end of the eleventh century, the Norse effort had shot its wad. It was just too damned much work, took too much out of a marginal economy, and contributed nothing to the Norse culture except some sagas.

Another commonly discussed pull-back is the withdrawal of the Chinese from an effort that could have built a trading empire extending from Africa to Melanesia. From 1406 to 1433 A.D., the Ming rulers of China sent naval expeditions southward in the China Sea to Java, India, Persia, Arabia, and Africa. Again, the driver was political: a search for a release valve for overpopulation and a reaction to increasing contact with the Europeans. At the same time, the Chinese were improving the defense of their northern frontier by extending the Great Wall. Expansion to the north was therefore blocked.

But China had an attitude problem. In the fifteenth century, the Chinese empire had no rival in the world. The Ming Emperor recognized other

states only as tributary or rebellious members of a world dominion bestowed upon him by Heaven. It made the Chinese smug and incurious. It lowered the vitality of their culture that was based upon punctilious manners, fine art, law and order, and a bureaucracy with indestructible traditions going back 3,000 years. The Ming Emperor's naval expeditions went looking for places to dump excess population and new states from which tribute could be extracted to help pay for a huge and expensive government.

When the Chinese came up against the Europeans—and even the Muslims—they discovered not only better technology arrayed against them but a level of management and decision-making capability that they lacked. If Europeans had any leg up on the rest of the world then, it was in their ability to make decisions and manage large operations. And to embrace change. This sort of shock to the Chinese system was untenable, and the Chinese withdrew into a xenophobia they are only beginning to overcome today.

Another one that few people know of was the disappearance of the Teotihuacan empire of Middle America between 700 A.D. and 900 A.D.

This civilization evolved a bureaucracy for the same reason that one emerged in Sumeria and Egypt several thousand years before. Around the main city of Teotihuacan, an extensive irrigation system had been built. It takes a joint, community effort to build, operate, and maintain an irrigation system. I live in a part of the

world that has one, and it is a glue that welds a community together; however, in the Phoenix area, it's managed by a private corporation whose stockholders are also land owners.

This early Mexican culture also developed a calendar because it was an agricultural civilization. In such early agricultural cultures, keeping track of the calendar is a task that is handled by non-farmers, the priests who are knowledgeable about the Great Mysteries of the Universe.

For some reason, this civilization built pyramids somewhat like those of the second dynasty of Egypt, but for slightly different religious purposes. Human sacrifice was an integral part of that religion. It may have been a response to the pressures of overpopulation that *always* impact early agricultural societies as well as those that have become successful (like ours).

However, in the sixth century A.D., Teotihuacan was abandoned.

Its imposing technical works—irrigation canals and the pyramids—were left to crumble.

Everywhere within this great Mexican empire, other ceremonial centers were abandoned as the years progressed. The pyramid sites went unvisited. The buildings fell to ruin. The jungle swallowed up many of these.

By 900 A.D., even the memory of this civilization was beginning to fade.

Why?

Is this a great mystery? Did it have some physical cause such as a change in climate? Was it caused by saliniza-

tion of the ground water system? (Irrigation systems have a tendency to leach salts out of the soil into the ground water.)

Archaeologists and anthropologists are now beginning to suspect that the collapse of the Teotihuacan empire wasn't mysterious at all. And it seems it wasn't caused by changes in climate, pollution levels, or the regional ecology.

They've discovered something that may be important for us to consider:

Many civilizations that build mounds and pyramids go through periods when *they give up the whole idea*.

After all, a pyramid city has marginal utility except to get rid of excess population by religious sacrifice. If the excess population either moves elsewhere or becomes somewhat lethal to round up, the major driver disappears. Or once you conquer all the imperial enemies and get rid of the "loyal opposition" the underlying rationale of being "necessary for national security" goes away.

If you need to know when to plant and harvest your crops, you can eventually figure it out for yourself. Or you can get a bit of advice from an experienced neighbor.

You suddenly discover you really don't need an official pronouncement from the priests of the pyramid.

The big party at the vernal equinox may be a lot of fun for everyone except those who are sacrificed.

But the Sun comes up whether or not you sacrifice virgins to it.

Soon the question arises: "Do we really need this?"

It costs money—taxes. You end up giving more and more of your output of grain or domesticated animals to the priests.

Practicality, pragmatism, matters of economics, utility, and parsimony can then become ascendant.

Once you discover that the pyramid priests don't help you put food on the table, you go about your business and begin to ignore them. You don't *need* the pyramid any longer.

The civilization begins to undergo a period of radical change.

The priests don't like this. Those whose jobs depend upon the priests and the pyramids don't like it, either. When this begins to happen in such civilizations, they commence a predictable series of steps to maintain the status quo. At first, they sacrifice more virgins until they run out of virgins (or the virgins go into hiding). Then they begin cutting the hearts out of the heretics until these dissenters discover they can resist or run—and they do. The next targets are the taxpayers. Tax collectors can be very ruthless. Undoubtedly, some people paid their taxes with their lives on the sacrificial altars of the crumbling pyramids.

Hey, folks, this sort of stuff makes for science fiction plots and backgrounds, especially for television! ("Look, Sol baby, here's the plot: We've got this interstellar empire with the evil emperor and his vile henchmen, see? And . . .")

Uh, dare I suggest the possibility that our Pyramid to the Moon could be an analog to the pyramids of Teotihuacan?

We built our space program on the foundation of national security during a period of threat to our civilization. That driver has gone away. We no longer need to supplicate the priests of the VAB.

We have a choice. We can follow the other great pyramid building civi-

lizations into cultural collapse. Or we can learn from them. We can change space into something that's useful and profit-making for our culture.

We can turn the pyramid into an office building. That will require a bit of remodeling, of course. So let's get with it. ■

IN TIMES TO COME

Our January double issue, marking our 64th anniversary, uses its extra room to feature three novellas: two big ones and one not quite so big. The cover goes to Michael F. Flynn's "Melodies of the Heart," a haunting tale of a haunted woman with quite a past, and a girl with not much future. But seemingly unrelated parts of the Universe sometimes complement each other in surprising ways. . . . Whether you're looking for a memorable story of interwoven lives, or a fascinating exercise in scientific speculation, you'll find both here, smoothly integrated in the way that has made Flynn an *Analog* favorite.

Doug Larsen's "Virtual Proof" is a suspenseful police procedural that raises nagging questions real police may have to deal with sooner than they think. Like, when is a crime not a "real" crime—or vice versa? "The Tetrahedron" is Charles L. Harness's first appearance in *Analog* in far too long. If you remember his earlier ones, you know you can expect a highly entertaining story with some surprising and highly original twists and turns.

Ian Stewart's fact article deals with "The Real Physics of Time Travel." Intriguing observation about that: until recently real physicists didn't talk much about time travel, but now quite a few of them do—yet they're still working with the same basic theories. How many other big surprises are still hidden on "well-known" turf?

Finally, it's time again to vote in the Analytical Laboratory, using the ballot elsewhere in this (Mid-December) issue. The January issue will contain the complete Index to 1993 to make that task easier. Your voting helps us bring you the magazine you want—but just in case you need the extra nudge, I remind you that every ballot will also be entered in a drawing for a free one-year subscription.

Jeffery D. Kooistra

PUFF

*As John Campbell liked to say,
you can't do just one thing. . . .*

Illustration by Todd Cameron Hamilton





LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"The problem with kittens is that they grow up to be cats." I'd probably heard that line a hundred times before I decided to do something about it. Of course, being a bioengineer, I had some idea of what was involved. But it turned out to be a near disaster. Very near.

And it's not over yet.

"Daddy, I want a kitty," my daughter Haley had said.

"Who'll take care of it?" I asked, not looking up from my work.

"I will." She was five. I knew she wouldn't. But when I ran my fingers through her chestnut curls, and looked into her hopeful hazel eyes, I couldn't resist her.

She named the kitten "Muffin." At first Haley played with her every day—rolling her a ball to bat around, dangling yarn for her to tangle with, putting her in the baby stroller with a bonnet on and taking her around the neighborhood. But after a while my wife, Dorothy, noticed some shredding on her curtains. And when she caught Muffin clawing her way up the back of the couch. . . .

Muffin was banished to the basement. The morning of her exile, I went to my job at National Biogen, looking upset because of the tearful fuss Haley had put up when Dorothy wouldn't let her bring Muffin into the kitchen. My buddy Steve asked me what was the matter.

"That's the problem with kittens," he said after I told him. "They grow up to be cats."

That's when it hit me that I could do something about that.

By the time I got home that night,

I'd already put the idea on the back burner. I had other work to do. But when Haley said good night to Muffin at the top of the basement stairs and closed the door, and when Muffin wailed and cried as only a cat can do, and when Haley bolted past Dorothy to crawl into my lap and cry herself. . . .

"It's not fair, Daddy. Why can't Muffin come upstairs?"

"Muffin is getting too big, honey. And she's too much of a cat. It's too late to turn her into just a house cat. She'd miss going outside too much."

"Why do kitties have to get big?"

They didn't, and I got to work on it that weekend.

A good deal of the necessary work for keeping an animal young had already been done, most notably with oxen. The idea had been to provide animals of varying sizes for the use of nonindustrialized societies. And a mammal's youth is the time when it can learn things quickly and easily. The young oxen, yoxen, have worked wonders in the poorer countries of Africa.

I was sure I could do the same with cats.

The first yoxen were made with virus driven genetic manipulation. It took years, but finally oxen were bred that matured to late childhood and then stayed that way for five or six years. After that, they would mature fully and die within another three or four years.

My first kitten matured at three times the usual rate, got cancer, and died. The second never grew up enough to take care of itself. The

third was "Puff."

Six months after Muffin's banishment, Puff was born in my lab. Right from the start I had a good feeling about him. He was weaned at the usual time, but while his three litter mates continued to grow, he lagged noticeably behind. After three months he was as grown up as he would get, until the final maturation spurt during the last few years of his life.

One year to the day after Muffin had worn out her welcome with Dorothy, she was killed by the strays.

I had never intended to give Puff to Haley. Shortly after Puff's birth, my work duties had changed with a small promotion, and I hadn't had the free time available to make more Puffs. I'd planned to keep him around the lab, and breed him during his mature period to see if he could sire his own kind.

But then Muffin took her last walk.

My house sits just outside the periphery of suburbia, along with half a dozen other houses, fields, wooded areas, and wetlands. Along with the birds, squirrels, and rabbits, was also a pack of stray dogs. We didn't see them often, but now and then a dead chicken would turn up at the neighbors', or a child would come home with a bite. We killed several, but there always seemed to be plenty more. Often they'd howl and bark during the night, somewhere out there in the darkness.

Haley had gone outside to call Muffin at dinnertime, and it happened to be one of those rare times when Muffin actually obeyed. She came out

from behind the shed at the far end of the back yard, and then quick as anything a big, black, mangy mutt and two smaller curs raced out of the trees. Muffin took off like a shot, Haley ran into the back yard, and I, coming on the scene at that point, ran after my daughter. I caught her, but I couldn't help Muffin too, and the drama played out to the end.

I drove the big black dog and one of the little ones away. Muffin had blinded the third before she bought the farm. I sent Haley into the house with Dorothy before I finished it. We buried Muffin next to the flower garden.

Haley cried herself to sleep that night. I brought Puff home the next day.

It was good for both of them. Haley loved her new tabby kitten, and Puff was free to roam the house. I'd had to keep him in a cage most of the time at the lab, but Dorothy couldn't continue with her no house restriction, not with what Haley had just witnessed. It didn't much matter, though. I'd already trained Puff in the use of the litter box, and he was really too small to cause much damage in the house. After a week, Dorothy did once catch him climbing the back of the couch, but after she rapped him off and scolded him, he didn't do it again. It was almost like he knew he had it good, and he'd best not upset the queen of the house.

Haley taught Puff some tricks. He learned remarkably quickly. Within a week Haley had him rolling over and playing dead, and fetching the yarn ball. I know, you don't usually teach

cats tricks like that, but Puff enjoyed it.

The summer passed, and my daughter continued to grow up before my eyes, but Puff didn't. Always he remained the eternal kitten, with all the friskiness and fluffy joy that implies.

Apart from his bioengineered differences, I first realized there was something else damn peculiar about Puff when I caught him roasting marshmallows.

Haley had learned how to roast marshmallows that summer when I took the family camping. She decided that, since a gas stove had a flame, she should be able to roast marshmallows over a stove burner just as well as a campfire.

"Come see, Daddy," she'd said, and I went into the kitchen to find her toasting a marshmallow on the end of a shish-kebab stick over the front burner. Puff was watching from the counter.

"That's nice, honey. Does your mother know about this?"

"She said it was OK." A half-truth. Dorothy had thought she'd meant roasting marshmallows the next time we went camping. But no matter, Haley was doing a professional job of it.

It caught fire. She pulled it back and blew it out.

"Careful, Haley. Don't burn down the house!"

"I won't, Daddy. That's how Puff likes them."

"What?"

She pulled the gooey mess off the stick and put it down by Puff, and he made short work of it. "Puff likes me

to burn them first," Haley said.

"I see."

Marshmallows over the stove went on for several days until Haley tired of it. I didn't think any more of it until one night when I came downstairs for a midnight snack. Before entering the kitchen I thought I noticed a dancing light, like there was a burning candle in there.

I crept in quietly.

The stove was lit, and Puff was on the counter, holding a shish-kebab stick in his mouth, on the end of which was a marshmallow suspended in the flame. The marshmallow caught fire, Puff pulled it out and, setting the burning mess on a plate, went and put the flames out with his paws. Then he started eating it like this was nothing unusual.

I turned the light on and Puff saw me. He gave me that "You're nothing to worry about" look and went back to eating his marshmallow.

I didn't know what to do. Saying "bad cat" seemed inappropriate. Still flabbergasted, I settled for letting Puff finish, then I put him in his box and shut him up in the closet for the night. It wouldn't do to have the family cat using the stove unsupervised.

I told Dorothy about it the next day, and some of our neighbors had to come over to see the wonder kitchen roast marshmallows. But eventually Haley explained to Puff that he couldn't use the stove by himself, and he stopped his evening cooking (or at least never got caught at it again).

Another peculiar trick of Puff's that shocked me involved his learning how to play a version of basketball

that Haley had devised. She tied a golf ball on a length a string, and dangled it over the hall from the top of the stairs. Then she'd taped a paper cup about a yard up the wall and made Puff try to bat the golf ball around until it went into the cup.

It was fun watching her train Puff. At first he didn't seem interested, just watching her swing the ball herself until she'd get it in the cup. But then she hauled out the Lucky Charms (which Puff adored) and Puff altered his attitude.

His first battings went unrewarded, but he persisted and seemed to understand what was desired. He finally managed a rim shot, and for that he got a Lucky Charm. Soon he had the distance pegged and was sinking four shots out of five, and getting decidedly full.

And then Puff started getting baskets on bank shots off the banister.

"Look what Puff can do now!" Haley exclaimed.

"How did you teach him to do that?"

"I didn't. You saw, Daddy. He figured it out for himself. Puff is a smart kitty!"

A swing around back the wrong way, *thock*, a bounce off the banister, another parabola across the hall, and *thunk*, into the cup.

"I should have named you Newton," I muttered. "Isaac Newton."

"Isn't Puff smart, Daddy?"

"Yeah. Puff is very smart, honey."

It had to be the result of the kitten brain remaining young. That's the only thing I could imagine that could lead to Puff's feline genius.

Most mammals do a phenomenal amount of learning when they're young—their brains are geared for it. Studies with children have shown that the early years are ideal for them to pick up several languages at once. After the age of five or six the ability to learn languages easily is usually gone forever. In Puff I had created a cat permanently stuck in the quick learning mode. Having mastered the usual kitty cat stuff in the first few months, Puff was free to learn other things, tricks that made him the most brilliant cat ever.

Visions played through my mind of a traveling cat show, with Puff and maybe a dozen other of my genius cats performing feats of mental prowess never before witnessed in the animal world.

Nahhh.

One day in the most crimson week of October, I was out in the garage sharpening drill bits on the grindstone. Puff was lying on the hood of Dorothy's car, still warm from a trip to the grocery store.

Puff had two favorite sleeping places aside from his basket. The first was on my wife's car, which led to no end of complaints from her every time she saw new paw prints. The other spot, also much to my wife's dismay, was on Dorothy's kiln. Dorothy's hobby is pottery, and I, not wanting to shell out the money for a small commercial kiln, had built her one myself. With a little girl in the house I'd made sure that the exposed surfaces never got hot enough to burn small fingers. This resulted in the top of the kiln remaining at a safe

but toasty 110 degrees when it was on, and Puff loved it.

Though oblivious to the grinding noises, Puff's ears pricked up when Haley called from the house. I could see her through the window as she left the back porch and started for the garage. Puff roused himself and jumped down from the hood, then scampered out the door.

Haley screamed.

I saw it through the window as the big black mutt, alone this time, made its return, showing flashes of pit bull ancestry, chasing my little girl. I grabbed a big pipe wrench off the bench and raced outside.

"Daddy, Daddy, help!" Haley screamed in terror, racing as fast as she could for the porch.

"Ya! Ya! Get out of here, you damn dog!" I hollered, brandishing the wrench. It paused and Haley made it to the door.

But the mutt saw Puff and started for him. Puff went the other way in a hurry and scaled the trunk of the birch tree nearly instantaneously. He stopped on a branch, back arched, fur up, hissing and spitting.

By then I caught up and got one good swing off, connecting with a solid *thud* on the mutt's hindquarters. It yelped and took off.

"You all right, honey?"

"I'm OK, Daddy. Is Puff all right?"

"Yes. I'll get him down." But as I reached up for him, I saw he wasn't looking at me. He was watching the dog, still running away through the brush, hatred—yes, hatred—in his eyes.

He wouldn't come to me. He came

down by himself an hour later, and we found him curled up on the kiln.

The next day I bought a rifle. I tramped all around the countryside every evening until dusk, but I couldn't find anything of the dogs except tracks. Puff would always greet me when I returned. "Not today, my little friend," I'd say. "I couldn't find them. And I couldn't find *him*." Puff knew which dog I meant.

But after sunset, every night, we'd hear them howling in the distance.

The leaves fell, and were raked, and then the snow came. Haley had her seventh birthday. We let Puff roast us marshmallows to celebrate. After supper I'd light a fire in the fireplace, and sometimes I'd tell Haley ghost stories, and the howling dogs, closer now, added an eerie atmosphere.

The dogs often came closer to the house during the winter, rooting through garbage cans, looking for food. Some of my neighbors actually left food out for the "poor doggies." I would have preferred serving up bullets.

But the one time I got a chance to shoot, I couldn't. But it didn't matter.

There were a few weeks before Christmas when Dorothy thought she was going nuts. "Jeff, you didn't take any of my clay, did you?" she asked one day.

"What would I do with your clay?"

"I don't know, but I'm missing a five-pound block."

"I haven't seen it," I said. "Have you asked Haley?"

I wouldn't have thought any more about it except that a couple days later she asked me if I'd seen her

thread.

"What thread?"

"The heavy nylon stuff. It looks like fishing line. I was sure I had a spool of it."

"You didn't leave it somewhere, did you?"

"I can't remember."

"Did you ask Haley?"

I heard no more about the missing thread, nor about other spontaneous disappearances, until it came time to carve the Christmas turkey. We were all there, Haley, my wife and I, her parents, my brother and his wife, and my mother. Even Puff was ready, crouching by his dish, waiting. They'd sat down around the table and were waiting for me to carve the bird.

"Honey, where's the knife?"

"Don't you have it? I thought you took it out to sharpen it."

"Nope," I said. I went to the drawer, rummaged around, came up empty. "I can't find it. Haley?"

"You know you don't let me touch the big knife, Daddy."

"See?" Dorothy said. "I'm not the only one losing things around here."

In frustration I turned to Puff. "How about it, cat? Did you see the knife?"

Puff just looked at me, blinked his eyes once, slowly, and yawned.

After Christmas Puff turned secretive. At least, that's how I thought of it. He'd always liked being outside, but that January, despite the cold and the snow, he seemed to spend an awful lot of time taking treks out back. Sometimes he'd leave the house in the morning and Haley wouldn't see him again until he showed up for

dinner. She missed him, too. He'd always been her best playmate.

The last time we saw Puff, it was just after dusk on Groundhog day, and a light snow had been falling earlier, coating the trees, so that now with the full Moon breaking through the tattered clouds, the world was lit like fantasyland.

"Jeff!" Dorothy called to me as I sat working in the study.

"What, honey?"

"You have to go after Haley, quick!"

"What? Where is she? What happened?" I said, rising immediately and heading for my coat.

"She was in the back yard calling Puff. He was coming and then that big mutt barked somewhere out in the fields. Puff ran back into the woods and Haley went after him." Dorothy was talking a mile a minute. "I don't want her out there with that dog running around loose! You should have shot it long ago!" Dorothy was convinced that she knew the big dog's bark, could distinguish it from any of the other mongrel barks, yelps, and howls that came wafting out of the night.

I got my gun, zipped up my coat, and went out into the cold. Haley had left easy-to-follow footprints in the snow, and I could tell she'd been running down the trail, following the accompanying paw prints of Puff. I set off myself, into the woods, across the field, then down into the hollow and up the hill on the other side.

The scene spread out before me when I topped the rise. Down below I could see Haley following the trail

through a hedge of bushes, heavily snow burdened, but with several animal tunnels cutting through as short-cuts. Trees were scattered around liberally, their limbs drawing white cracks in the sky. "Haley!" I called. "Come home now."

She turned, looked around confused, then spotted me. "But Puff is still lost out here. And that dog is somewhere around, too," she hollered back, frustrated.

As if on cue, the black demon mutt from hell came over a small rise and plunged toward my daughter.

"Haley! Run, honey, run!"

She ran. She had thirty feet on the mutt. I had the stock of the rifle up to my shoulder . . . steady . . . steady. Haley came through the gap in the row of bushes. Suddenly, the dog veered off the trail. He was heading for one of the shortcut tunnels.

And Haley would be running past the opening where he'd emerge. I'm no marksman. I couldn't risk shooting him as he came out, not with my daughter near by. I felt helpless.

The dog disappeared from view. He'd be in the tunnel now. I saw something move just to the right. I heard a yelp. The dog didn't reappear.

It was Puff that had moved. He'd jumped from a tree by the tunnel, but he wasn't falling. Like a spider on a thread he slowly descended to the snow.

Something flashed in the moonlight, like a trail of stars following a graceful, descending, concave arc—a pendulum bob, or something like it. The bob went behind the hedge. An instant later came another yelp, and

a thrashing, and a howling in agony.

Puff raced away into a stand of scrub pines.

I ran down the hill to Haley. She was just standing there, confused and trembling. "Are you OK, sweetie?" I wrapped her in my arms.

"What happened, Daddy? Where's Puff?"

"Puff will be fine. But stay right here a minute—I want to go see what happened to the dog."

"I wanna come."

"No."

I walked to the other side of the bushes. The dog lay there, shuddering, Dorothy's carving knife sticking out of its gut, a big lump of clay enveloping the handle to give it weight. The mutt's head was stuck in the tunnel. I looked closer. He was trapped—a snare tightly encircling his neck.

I pulled the knife out, then plunged it in again. The dog stopped shaking.

I took Haley home.

Puff didn't return that night.

I went out the next day to investigate things more thoroughly. Puff, my genius cat, had laid his trap carefully. The snare had been cunningly placed in that tunnel, the only one big enough for that particular black dog to get through. It was made of nylon sewing thread wrapped in thorns. Puff had waited in the tree for the dog to get to the tunnel, then jumped, holding on to the triggering thread, which pulled the snare tight as he descended. And Puff had rigged it so that the carving knife, suspended by more thread and weighted by pottery clay, would be released to follow its

deadly trajectory right into the prey.

It was cunning. It was brilliant. Puff had topped himself.

If I ever see him again I'll kill him.

There was one other thing Puff needed to ensure the success of his enterprise. He'd deliberately led Haley out into the woods when he heard the dog. I followed his tracks. He'd run ahead on the trail, then veered off and doubled back to reach his spot in the tree. She'd followed as Puff had known she would.

The simple fact of the matter is this: *Puff had used my daughter for bait.*

It took some doing, but I finally freed the mutt's head from the snare. Some of the thorns had gone in deep. I couldn't bury the carcass because the ground was frozen, but that didn't matter—the dog didn't deserve a burial. But I didn't want Haley to find it so I carried it out deep into the woods and left it for the scavengers.

We last saw Puff four years ago tonight.

Haley is eleven now. She still misses

Puff. Sometimes she leaves an open bag of marshmallows on the back porch, hoping Puff will find them, will return home. The marshmallows disappear, but we never see Puff.

I had a chance to look into my notes on Puff's development and what could be expected. Last year he would have had a huge growth spurt, turned into an adult in just a few months, and started to breed.

And his genes are dominant.

I took a walk in the moonlight tonight, deep into the woods. I found evidence of a fire, and saw several long, thin sticks with what I'm sure is burnt marshmallow residue on their charred tips. And all around the fire were little paw prints, about right for five or six kittens, I'd say. And one set of bigger prints, about right for a mature cat.

I came home and stood outside the door for a moment, listening to the silence.

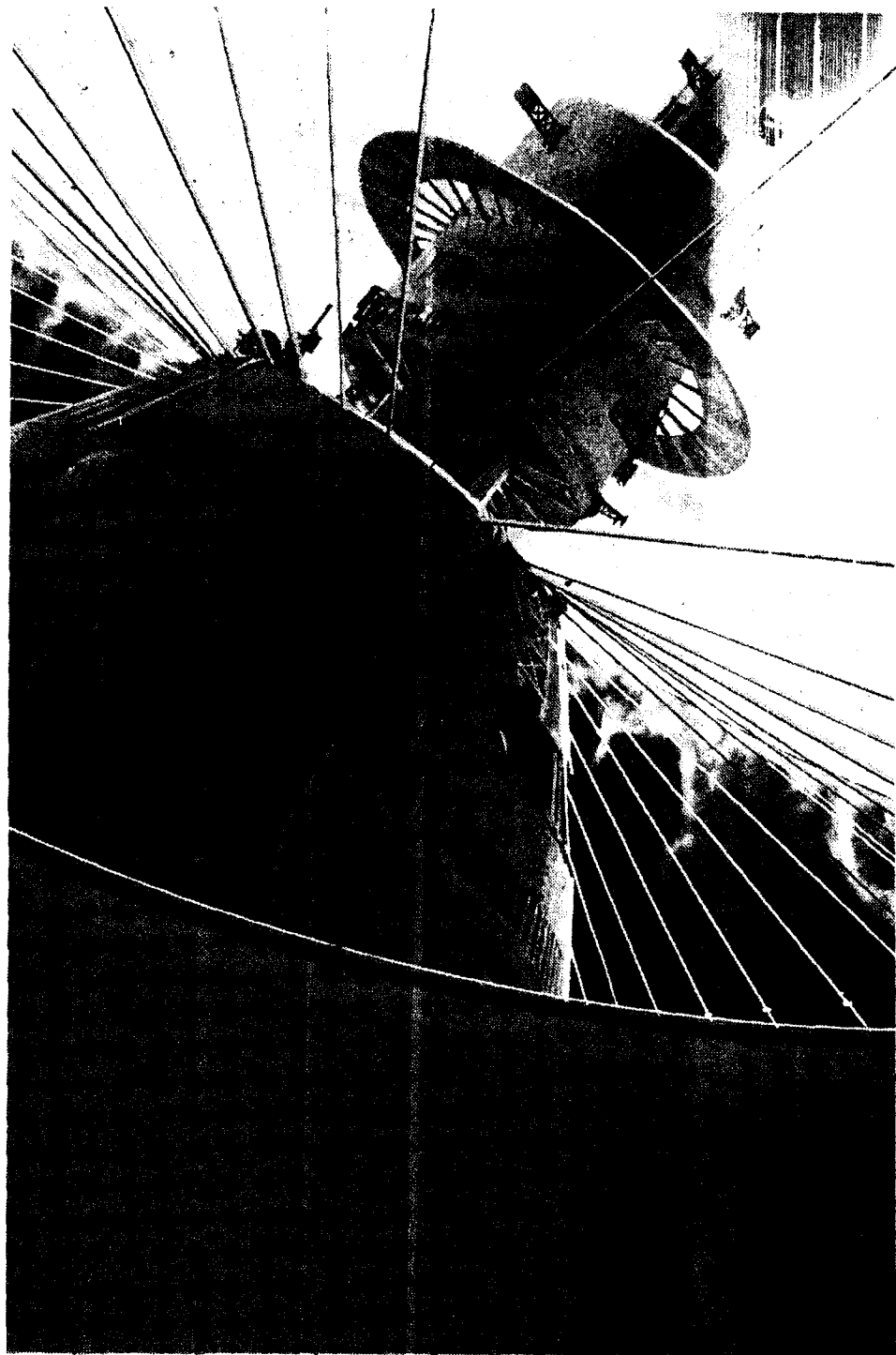
We never hear dogs barking anymore. ■

If the universe is expanding, are we getting taller?

Greg Holt

No, wider.

Ed Pell



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Joe Martino

PAPER VIRUS

Scientists advance by “standing on the shoulders of giants”—and all the hidden assumptions they made!

Illustration by Nicholas Jainschigg



"This settles it. Faster-than-light travel is impossible!" Gerhard Kuntz leaned back in his chair, a look of triumph on his face, and pointed at the symbols on the computer screen.

Hal Morton hunched forward in his chair. "If you're basing your proof on general relativity, it might not hold up.

"In the six months we've been orbiting Mercury, we've collected tons of data about the Sun's gravity field. Not only from the vicinity of Mercury, but from probes sent into close orbit around the Sun. In that time we've collected more data on intense gravity fields than in the whole prior history of the science of astronomy.

"It's clear from the data we already have that Einstein's General Theory is only an approximation to reality, just as Newton's Laws of Motion were. Even in gravity fields no more intense than those we've studied here, there are discrepancies between the general theory and our measurements. A new theory of space-time is going to be needed."

"That's precisely why I made this trip in here to your research station," Kuntz replied. "I had been developing a new theory of space-time, which would extend general relativity to more extreme conditions. However, I needed data on extreme conditions to check it.

"When I looked over the protocols for the experiments you people were conducting, I realized that some of your data would give my new theory a crucial test. I was able to get a UN grant to make the trip in here, rather than wait for you to publish.

"I'm pleased to say that your data do support my theory. The results are clear-cut." He gestured again at the computer screen.

"And I must say," he added, "I appreciate your willingness to let me look at your data while your research is still in progress."

Morton made a gesture of dismissal. "That's no problem. This was planned from the outset as an experimental study, and we'll publish our data as soon as we've finished collecting it. Anyone else who wants an early look at it is welcome to come in here just as you did."

Kuntz continued, "Am I right that you hoped a new theory would open the door wide enough to admit faster-than-light travel?"

"I did have some hope of that, but that wasn't the primary reason for my research."

"Well, I'm sorry to slam that door shut again."

"Would you let me have a copy of your derivation?"

Kuntz hesitated a moment, then spoke. "It would be ungracious of me to refuse, after your kindness in allowing me to use this expedition's data. But it will have to be with the understanding that you don't refer to it until it's accepted for publication."

"Of course. Just as you've already agreed not to preempt our publication of our own data."

Kuntz turned to the keyboard and copied his work to a file in the main computer memory. "There's the file identifier. You can retrieve it yourself."

"Thanks." Morton stood up. "Does

this mean your work here is complete?"

"Yes. I'd like to return to Earth on the next supply ship. That will be here in three days, will it not?"

"Yes. I'll take care of the administrative details of getting you on the passenger manifest."

"Thank you."

"You're welcome. See you at dinner." Morton stepped out of the work cubicle which had been assigned to Kuntz, and headed for his own office.

Morton booted up his own computer, and logged on to the station's main computer. He located the file Kuntz had made for him, made a backup copy in write-once memory, then downloaded a copy to his computer's permanent memory. He'd formed the habit of taking so many precautions because, as the main machine's system operator, he was always urging others to back up their files. It would set a bad example if he didn't follow his own advice, and would make him a laughingstock if he lost one of his own files as a result.

Then he started reading through the file. Before studying it in detail, he decided to skim through it to see what the logic flow was in Kuntz's work.

From the first line, he realized he was in over his head. His real forte was instrumentation, not theory. Nevertheless, as a gravity researcher, he simply had to know general relativity, and the mathematics of vectors and tensors in which it was expressed. Kuntz was doing something different. Apparently the starting

point for his new theory was topology. Morton struggled with that for a while, decided he'd eventually be able to make sense of it, then moved on.

The next part seemed clearer. Kuntz had (somehow) developed a topological model for the curvature of space-time, a model which was more elaborate than general relativity. The model had several adjustable parameters in it. Kuntz had used the gravity data Morton's team had collected to calibrate those parameters.

OK, that seemed to make sense. Morton was used to fitting models to data. He scanned Kuntz's analysis quickly. Kuntz had begun by splitting the data into two halves. He'd used one half to evaluate the parameters, then used the resulting model to predict the other half of the data. The average error in the prediction was very small, implying that the model accurately described how space-time was curved in the vicinity of the Sun.

However, were the two halves of the data actually independent of each other? If not, the model was merely regurgitating what it had been fed. Morton decided that he'd better have Sam Nakamura, the station's data reduction specialist, take a look at that part of the analysis.

OK, skip ahead to the next part. Kuntz had taken his model and applied it to the issue of velocity of light. In this allegedly improved theory, was the velocity of light still the universal speed limit?

Morton skimmed over line after line of algebra. No point in checking that. The derivation had probably

been carried out by the computer's symbolic manipulation program. If so, it had to be right. That could be checked later, if necessary.

He then came to a line where Kuntz had invoked something called Gorshkov's Theorem. The display indicated there was a hypertext reference to the theorem. Out of curiosity, he placed the cursor on that portion of the derivation and hit the hot key. A window opened on the screen and displayed a reference to an article in the *Journal of Computational Topology*, dated some thirty years earlier.

He returned to the derivation. Using Gorshkov's Theorem, Kuntz had transformed the expression for the speed of light—*Beep, Beep, Beep*.

The intercom interrupted his thought. He cursed as he keyed it on. "Morton here."

The voice was that of John Foglio, the station's director of operations. "Chief, we got a problem."

"What's that?"

"A sunspot below us looks like it's about to flare. Probability 85% and climbing. Estimated time about two hours from now."

"What's the problem? We're armored against all but the biggest flares. Will this one be bad enough that we'd better order everyone into the storm cellar?"

"No, it doesn't look that bad. The problem is that Alexandrov is out in the shuttle, retrieving a solar probe. He's due back about the same time the flare is forecast. It'll be nip and tuck for him to make it back ahead of the flare."

"Is there anything I need to do

about it?"

"Nothing at the moment. Alexandrov knows about the flare, and he's returning at maximum acceleration."

"What about other ships in nearby space? Are we likely to have someone wanting to use our sick bay?"

"Our resupply ship, the *Hermann Oberth*, is on schedule, three days out."

"They have a storm cellar, like other freighters. The flare shouldn't bother them. What about those UN Space Service ships? Are they still running maneuvers around Mercury?"

"Yes. The mother ship, the *Ellison Onizuka*, had launched some fighters. I sent them a message to warn them about the flare, but they had already forecast it themselves. They expect to have all their fighters recovered before the flare erupts. They have some ships on picket duty well inside Mercury's orbit, though."

"All their major ships are normally armored against radiation warheads. A solar flare shouldn't bother them at all. Will their fighter operations interfere with Alexandrov's probe recovery?"

"No. As we agreed when they arrived, I provided them with the probe's orbit and they moved their operation elsewhere. They're well clear of the probe and of Alexandrov."

"OK, then Alexandrov is our only problem. Tell him to abandon the probe if he needs to lighten ship."

"I'll do that." The intercom gave a click as Foglio disconnected.

Morton tried to return to Kuntz's

analysis, but couldn't concentrate. He'd accepted the job of station director knowing that he'd spend more time on administration than on science. However, he hadn't anticipated that administrative tasks would interrupt his research as often and as extensively as they had. His one proposed experiment had been approved by the UN peer review board, and he'd completed it over a month ago. But with the press of administrative duties, he still hadn't been able to give the data more than a cursory look. That was a major source of frustration for him. Like most of his experiments, this one had begun with a hunch. He'd converted that into a testable hypothesis, then laid out an experimental program. The sample of data he'd found time to look at seemed to support the hunch. Not that it mattered. The hypothesis had ramifications throughout gravity theory. Whichever way it turned out, true or false, his results would be important. Nevertheless, he was human enough to want his hunch to be right.

With a sigh, he saved the file he'd been working on, and transmitted a copy to Nakamura, with a request to check the data analysis portion. Then he called up the project schedule on the screen.

The probe Alexandrov had under tow had been sent into the lowest orbit yet about the Sun. The uncertainty about the strength of the Sun's gravity field that close in had meant that the probe's trajectory couldn't be predicted with very high accuracy. The probe was bound to miss the station on its climb back from the

Sun. It had to be retrieved using the shuttle.

What would be the impact of losing the probe? The data in its recorders was not duplicated by any other probe mission. That made either recovery or replication of the experiments terribly important. There were other probes available. What were they scheduled to do? Could the orbit of this probe be repeated using another one without cancelling any other measurements? Could it be repeated within the time left for completion of the expedition?

He started to shuffle the schedule around, trying different sequences of probe flights. Nothing worked. Two probes had been lost already. There wasn't enough slack left in the schedule. Something would have to give. Loss of this probe, and its data, wouldn't exactly be a disaster, but it would be bad news. Something of lower priority would have to be dropped.

He really hoped Alexandrov wouldn't need to abandon the probe. If it were lost, priorities would have to be set, and some of the scheduled data simply wouldn't be collected. Even more than the loss of the data, he dreaded the task of telling some of the researchers that their experiments didn't make the cut, and they'd have to go home without their data.

Morton clung to a handhold at the airlock leading to the shuttle dock, on the axis of the station. He'd spent the past hour there, staring alternately at the video display of the Sun's surface, and the radar display showing Alex-

androv's shuttle. Weeks ago he'd finally conquered space sickness; being in free-fall no longer bothered him. Nevertheless, he didn't like it. He really wanted to be down on the station's rim, where the acceleration was Earth normal. However, he knew if he went down there, he'd simply pace the floor. He might as well fret here as there.

The sunspot at the center of the video display was definitely looking angrier. The radiation count outside had begun to rise, but was still within the limits the shuttle's armor could handle.

Alexandrov's voice rattled through a loudspeaker on the wall. "I'm beginning maximum deceleration. I estimate I'll match station orbit about half a kilo out. Be ready to grapple the probe and haul me in."

Morton watched the radar display. The blob that was Alexandrov's shuttle was definitely starting to slow. At six *g*'s deceleration, Alexandrov had to depend on the automatic pilot. The velocity vector would take the shuttle slightly to the side of the station. Despite the urgency of the situation, Alexandrov wasn't going to risk ramming the station.

The shuttle and its tow were soon resolved into two distinct blobs on the radar display. They seemed to creep towards the station. Morton stole another glance at the video display, didn't like what he saw, and looked back at the radar. The shuttle was finally at rest relative to the station.

Foglio's voice came over the speaker. "Launch the grapples. Get

that probe pulled inboard promptly."

Things happened efficiently, but with what seemed to be maddening slowness. Grapples were launched from the station by a blast of CO₂. Their lines paid out smoothly behind them.

"Grapples are hooked on the probe," came Alexandrov's voice.

"Release the probe from the shuttle," Foglio ordered.

"Done."

Another video display came to life, showing the shuttle and the probe. The probe started moving toward the camera. Puffs of steam appeared near the shuttle, then vanished. It drifted out of line with the probe. More grapples were launched, this time toward the shuttle.

"The grapples missed me," Alexandrov reported, his voice showing no sign he was aware of the rising radiation count, or the appearance of the Sun.

"Cut them loose," Foglio ordered. "There isn't time to haul them back in. Launch another set."

"Got me this time," Alexandrov reported. "Start hauling me in."

The shuttle seemed to creep closer with agonizing slowness. The grapples could pull but not push. Therefore the shuttle's velocity relative to the station mustn't exceed what the shock absorbers in the shuttle dock could handle.

Finally the shuttle dock door was closed, and Alexandrov was safe inside. Morton breathed out a huge sigh, then noticed that the palm of his free hand was bleeding where he'd dug a fingernail into it. The other nails

had left deep marks but hadn't broken the skin. He hadn't realized the tension he'd been under. Then he felt a rush of shame as he realized he was as glad about the successful recovery of the probe as he was about the safety of Alexandrov.

He sucked at the superficial wound in his hand, then launched himself toward the elevator that would take him down to the rim of the station.

At the end of his shift, Morton headed for the station's mess hall-cum-lounge. He surveyed the selection of frozen dinners, and reflected that it was easy to tell that a supply ship was about due. All the popular meals had been eaten already. He picked ham and lima beans as being the least objectionable choice left, grabbed the package and headed for one of the microwave ovens. As his dinner was warming, he spotted Kuntz and Alexandrov seated together. He decided to join them.

"Mind if I sit with you?"

"Not at all," Alexandrov replied.

"Mikhail here was just about to tell me how he happened to resign from the UN Space Service to take the job of shuttle pilot on this station," Kuntz added. "But I suppose you already know about that."

"As a matter of fact, I don't. I didn't want to pry into your private affairs, Mikhail, but if you're telling about it, I'd be interested."

"Actually there's not that much to tell. I joined the UN Space Service because that was the only way I could get a space pilot's rating. I couldn't afford any of the schools for commer-

cial pilots, and the Russian space force has been cutting back, not recruiting more pilots."

"Same for the American force," Morton said. "The UN is about the only route to a pilot's ticket these days, unless you can get a commercial space line to put you through pilot training."

"Anyway, after I graduated from pilot training with a lieutenant's rank, they put me on one of the stations in GEO."

"GEO?" Kuntz asked, eyebrows raised.

"Geosynchronous Earth Orbit."

"And what were your duties there?"

"Flying with a space-fighter squadron. We did lots of practice. Intercepting targets. Firing dummy missiles at them. Breaching and boarding spacecraft. But who were we going to fight?" He gave a shrug. "We outnumbered the American and Russian forces put together. Throw in the Indians and the Chinese and you still couldn't match us."

"We ended up being a babysitting agency. Rescuing people who did something stupid and got themselves into trouble. This expedition promised some adventure. I piloted one of the tugs that hauled the station in here, then stayed on to pilot the shuttle."

"But surely the Space Service does more than just play war games and act as nursemaid."

"True. Occasionally we rescued people who got in trouble through no fault of their own. But I soon got tired of it. When this chance came up

I turned in my papers. I still hold a reserve commission, and will have to go through refresher training every so often. I don't expect them to call me to active duty, though, unless they find someone to fight."

"Why didn't you resign before?" Morton asked.

"And do what?" He shrugged again. "Flying for one of the commercial space lines would be even more boring than what I was doing. Two years ago I applied for the expedition to the Jovian moons, but all the places went to pilots with more experience than I had."

"You must have gotten your fill of adventure today."

"It was close, but I was confident I'd make it. John Foglio warned me about the flare as soon as he had a forecast, while I was still outbound. I knew I'd have to do everything right the first time in order to retrieve the probe and make it back before the flare, but that simply put a little spice in the day. As my former squadromates would put it, 'This is the day you earn your pay.'"

"I am certainly glad you succeeded," Kuntz said.

So *am I*, Morton thought to himself.

Kuntz continued. "Mr. Nakamura let me have some of the results from his first look at the data on the probe you recovered. That allowed me to check my theory in an even stronger gravity field than I could with the previous data. It still checks out."

"It's too bad you're leaving now," Morton said. "We have another probe which is making a polar tour of the Sun rather than the equatorial tour

the one we got back today made. Most of its trajectory was at lower gravity fields than today's probe explored, but in its passage over the poles it actually experienced a stronger gravity field than any other probe on our schedule. It's due to reappear from behind the Sun's south pole within the next six hours, and will be back here at the station within a couple of weeks."

"It's unfortunate you cannot telemeter the data back here," Alexandrov said.

"That's turned out to be impossible. The noise level from the Sun is too high. At any bandwidth narrow enough to cut through the noise, the data rate is so low we'd recover the probe physically before we could read out all the data. We're stuck with a two-week wait."

"I really cannot stay that long," Kuntz said. "However, I will await with interest your publication of the data. I do not expect any surprises from whatever the probe may find. Now if you will excuse me, I want to take another look at the data Mr. Nakamura gave me."

Alexandrov stood up and gestured toward the door of the lounge. "And here is Sam himself, for our nightly chess game."

Alexandrov's and Nakamura's chess games had become legendary. They were about evenly matched, and both in a class well above the rest of the chess players on the station. While there were several chess games played every evening in the lounge, their nightly matches always drew the biggest crowd of kibitzers.

"You and Sam must know each other's moves by heart after six months," Morton said.

"Unfortunately, no," Alexandrov replied. "He pulled a surprise on me last night. It's my turn to surprise him tonight."

Morton forced himself to finish the rest of his meal, then headed for his office. The monthly reports were due, and he couldn't put them off any longer.

The sound of the alarm clock jerked Morton out of a sleep that had been all too short. Finishing the monthly reports had taken him well into what was supposed to be his sleep period. However, he'd managed to get them transmitted back to Earth. Today he could start on a fresh set of problems.

He glanced at the intercom. The message light was on, indicating someone had left voicemail for him during the preceding shift. Whatever it was, the sender evidently didn't think it was important enough to disturb his sleep. He decided it could wait until he'd finished breakfast.

He showered, then heated a cup of coffee in his microwave oven. He had just started dressing when the intercom beeped.

"Morton here."

"Señor Morton, this is Luis Morales."

Morales was principal investigator for the experiments on the solar polar probe. What was his problem? He ought to be delighted that he'd soon have his data.

"I need to talk to you about re-

scheduling my high-latitude experiments."

"Wait a minute Luis. You haven't even seen your data yet. What's this about rescheduling?"

"The probe is missing! Have you not heard? I need to repeat my measurements."

"The probe is missing? Hold it, Luis. I had a very short night, I'm still on my first cup of coffee, and I haven't had breakfast yet. Let me get myself organized, OK? I'll call you back."

The probe missing? Another one lost? He decided he'd better listen to his voicemail.

"Message for Hal Morton. This is Jim Donnelly in Tracking. The solar polar probe is now three hours overdue. Even given the uncertainties in the orbit, the probability is about five nines that it's lost. If there's any change in status, I'll leave you another message. Out."

There was no other message. Evidently the probe had never showed up. Now what? Reschedule the solar polar mission? Was there time before this crew packed up and turned the station over to the next crew? And what other experiments would have to be scrubbed to make room for it? Should it be scrubbed instead? This wasn't going to be a good day.

Morton took a bite from a donut, washed it down with a swallow of coffee, licked the sugar off his fingers, and returned to his keyboard. Yes, there would barely be time to repeat the solar polar experiments, although Morales would have to take his data home with him and analyze it there.

But was it important enough to replace some of the experiments already scheduled? He started scanning the peer review ratings each of the approved experiments had received back on Earth, before the experimental schedule had been put together.

The intercom beeped.

"Morton here."

"Dr. Morton, this is Pavel Kasmirski. There are rumors you are planning to reschedule the solar polar experiments. I know the probe schedule is already completely filled. I trust you are not planning to cancel my measurements on the higher harmonics of the solar gravity field to make room for the solar polar measurements."

"Pavel, I haven't made a decision yet. Something will definitely have to be cut. If I leave the schedule as it is, we'll miss out on our only high-latitude measurements. If I decide to repeat them, something else will have to go."

"But Dr. Morton, my experiments are all good physics! They all received 'EXCELLENT' ratings from the peer reviewers. You can't be thinking of canceling them."

Morton spoke in a tired voice, "Pavel, every experiment on the schedule received the highest peer review ratings possible. At least twenty experiments were rejected for every one approved. The UN wasn't willing to fund this expedition unless every experiment on the schedule was absolutely the best possible in its particular area of gravity research. Now let me try to work out the schedule as best I can."

He shut off the intercom without waiting for a reply. He hesitated a moment, then disconnected it completely. Kasmirski was simply the first, he thought. Every PI on the station would be calling him, arguing that their experiments shouldn't be the ones canceled.

He could sympathize with every one of them. Their proposals had received the most thorough review in the whole history of UN-funded science, and had come out on top. Moreover, this particular expedition was probably their one shot at doing their experiments. The next expedition to use the station would be exploring the details of nuclear reactions in the Sun. There might not be another expedition doing solar gravity research within the lifetimes of these PIs.

Nevertheless, the call from Kasmirski had cleared his mind. There was no point in his trying to rank the scientific merit of the various experiments. That had already been done by the UN's peer reviewers. These experiments were the best that human minds could conceive at the current state of scientific knowledge.

That, Morton thought, had always been one of the weaknesses of the whole project. Something discovered during the course of the expedition might completely alter the ratings of the experiments. Perhaps even one of the rejected experiments would have turned up information which, taken together with what had been learned in the past six months, would have been more valuable than one of the approved experiments. Nevertheless,

his instructions had been to stick to the approved experimental schedule no matter what. Only in the event that the schedule was physically impossible to complete was he to delete any experiments. This possibility had been considered so remote that he hadn't even been given any instructions about how to choose from the approval list. Nor was there any point in referring the problem back to the science administrators at UN headquarters on Earth. He knew more about the current situation than they did. It was up to him to make the decisions. "This is the day you earn your pay," as Alexandrov would have put it.

Ultimately he decided to schedule the remaining experiments in such a way that every PI got something but no one got their entire list. That way, he told himself, he wouldn't make any enemies. Every PI would realize his own data-gathering could be increased only by cutting down someone else's. That way any resentment could be deflected from him to other PIs.

Nevertheless, the decision bothered him. If his solution was based on pure spread-the-misery politics instead of science, why put a scientist in his job instead of some career administrator? Was it fair that others would go home with only part of their data when his only scheduled experiment had been completed a month ago, never mind that he still hadn't found the time to finish analyzing the data? Nevertheless, he told himself he had no other choice.

He spent the next several hours

shuffling the schedule around. Unfortunately, the experiments couldn't simply be swapped in and out like children's blocks. While the experimental packages were standardized in size and shape, they all had to fit into the payload bay of a probe. All the experiments on a given probe had to be compatible with the orbit of that probe, and with the probe's pointing angles and rotation rates throughout the orbit. Their total power requirements couldn't exceed what was available from the solar panels at any point in the orbit. He felt that putting together a compatible set of experiments was something like assembling a three-dimensional jigsaw puzzle. He turned most of the task of matching up experiments and probes over to a computer program, but he still had to do some fine-tuning of the results by hand.

He was able to work things out so that Morales would get his measurements over the Sun's poles, but some of his remaining experiments would be replaced by others which were compatible with the probe's orbit. Kasmirski would get some of his data, but the experiments would be divided among several probes. He told himself, that's why the station chief should be a scientist. He might have to make a purely political decision about canceling experiments, but at least he could allocate the remaining experiments to collect the maximum possible amount of data.

He posted the revised schedule on the computer bulletin board, then headed for Nakamura's work cubicle.

* * *

Morton stuck his head into Nakamura's cubicle. "Got a few minutes?"

"Sure, chief. You looking for a place to hide from the angry mob?"

"For a while, anyway. However, the station's small enough that they'll find me soon. Until they do, I'd like to go over Kuntz's work with you."

Nakamura pulled another chair up beside his computer, and gestured for Morton to sit down. "I looked at the data analysis part, as you asked me to. It looked OK. He randomized the data halves properly. He used standard analysis procedures. He used the proper checks for validity, and they were all within acceptable limits. I'd say his model fits the data very well."

"However, there are some more powerful tests I'll probably run, if I get time later today. I told him I'd try to give the results to him before he leaves."

"Did he ask for them?"

"No. In fact, he didn't even seem to know the analysis techniques existed. That's not surprising, I guess. His training seems to be in topology, not data analysis. I'm doing it just because he's presented me with a challenging problem."

Morton slumped in his chair. "OK, I guess it's not my problem. I'd like to dig into the derivation of his model, but I know I'm going to be too busy for that during the next couple of months. Especially since re-shuffling the experiments is going to play hob with all our schedules."

"I went over the derivation briefly with Kuntz yesterday," Nakamura said. "I took a couple of courses in topology as electives in graduate

school, and was interested in what he'd done. My data analysis workload should actually drop since you'll be cutting out some experiments. That will give me a chance to play with Kuntz's derivation."

"Well, have fun with it if you want, but don't let the data reduction fall behind schedule. I don't want people taking a backlog of data home with them if we can help it."

He started to get up from the chair, but Nakamura put out a hand to stay him.

"Hal, the mob hasn't yet come to string you up with a printer cable and burn you over a pile of computer printout, and all the computer resources allocated to me are already at work crunching data, so there's nothing else I can do at the moment. Stick around and let me show you something. Have you ever seen the proof that all triangles are equilateral?"

"All triangles are *what*?"

"Equilateral. You know, all sides and all angles equal."

"But they're not."

"Sure they are. I can prove it." He began sketching a triangle on his computer screen. "Look, here's a generic triangle. Vertices A, B, and C. Now let me erect perpendicular bisector of the base at point P. Now I'll bisect the angle ACB. The point where the angle bisector intersects then perpendicular bisector of the base is point O."

"OK. Now what?"

"First, let's look at triangles AOP and BOP. They're right triangles, by construction. OP is common to both,

and by construction AP is equal to PB. Therefore they're congruent. So AO is equal to OB, and the angle OAP is equal to angle OBP. Right?"

"Looks OK so far."

"OK, now I'm going to erect perpendiculars from sides AC and BC to point O."

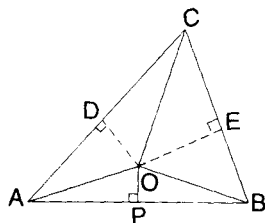
"Do those perpendiculars bisect the sides?"

"It will turn out they do, but that's not part of the proof. All I need right now is for them to be perpendicular to the sides."

"OK, go ahead."

"Now let's look at triangles DCO and ECO. By construction they're both right triangles. By construction, angle DCO is equal to angle ECO. Therefore angle DOC is equal to angle EOC. Right?"

"I think I'm being flimflammed somehow, but it looks right."



"OK, you accept that. Let's go on. Since the corresponding angles are equal, the triangles are similar. Also, they have side OC in common, and that means they're congruent. Therefore DO is equal to EO and DC is equal to EC. Right?"

"I guess I have to accept that."

"Of course you have to accept it. You can't deny the logic of geometry. Now consider triangles DOA and EOB. They're right triangles. I've just

shown that DO is equal to EO, and we've already seen that AO is equal to BO. Invoking the Pythagorean Theorem, AD must be equal to BE. Therefore side AC is equal to side BC, and angle CAB is equal to angle CBA. Thus the original triangle is isosceles, with C the vertex and AB the base. By a similar argument, I can show that angle ACB is equal to angle CAB, and therefore the triangle is equilateral. And since I didn't use any special properties of the original triangle itself, the proof is perfectly general. All triangles are equilateral." He sat back with a broad grin on his face.

"Now wait a minute," Morton protested. "This can't be right. I know that not all triangles are equilateral. Let me go through that proof by myself. You've pulled a fast one on me somewhere."

"There's no point in going through the proof. It's perfectly correct. Are you sure you've never seen this proof before?"

"I'm positive I'd remember it if I had. The conclusion is so absurd I couldn't forget it."

"I guess I thought everyone knew it. It was sort of a rite of initiation for the math majors at my college. We were shown the proof, and we had to find the flaw in it."

"Then there is a flaw!"

"Of course. As you said yourself, you know that not all triangles are equilateral. But the thing of it is, if you simply go over the proof, you'll never find the flaw."

"Why not?"

"Because the flaw is in the original assumptions. Look at the drawing. It

isn't to scale. If you tried drawing it to scale, you'd find that the perpendicular bisector of the base and the bisector of the vertex angle never intersect inside the triangle, except in an isosceles triangle. I fudged the drawing to make the proof look plausible.

"One of the surprising things about this trick was that the upper class members never tipped off the new students. Each incoming class had to figure it out for themselves. There was a purpose in that. When we reached classes in mathematical logic, the instructors used this example to show us that if you allow two contradictory premises into a system of logic, you can prove *anything*. Anything at all."

"I guess that's worth knowing. But I'm not surprised I'd never run into this trick. I went through some rites of initiation too, but they all had to do with subtle errors in instruments."

"You know, Kuntz had never heard of this proof either. So I showed it to him. But when I finished it, he got quite upset. I didn't expect that. I thought he'd enjoy the joke."

"Maybe he has no sense of humor."

When Morton returned to his office, he found a stack of messages from various PIs wanting to swap experiments he'd cut out for those he'd approved for the bob-tailed schedule. Well, he told himself, maybe scientific merit will play some role after all in making up the schedule. Surely the PIs themselves are in the best position to set priorities among their own experiments.

With a sigh, he set to work recom-

puting the schedule he'd worked out earlier. Somehow, he managed to accommodate most of the requests for change. However, he had no remorse about those he couldn't accommodate. The PIs who had proposed the experiments had gladly accepted the high ratings of their scientific peers. Now they had to live with the results.

He posted the revised schedule, looked at the clock, and realized his shift was supposed to be over. In principle, like the captain of a ship, he was never really off-duty. However, most days that was a meaningless formality. Today, and probably for the next several days, it would become a very accurate description of reality for him.

He headed for the lounge, grabbed a meal from the freezer without even looking at it, heated it, and sat down at an empty table. He looked around and suddenly realized that the lounge was almost vacant. What had happened to the chess crowd? Probably, he thought, most of the scientists were busy with their revised experimental schedules. However, that wouldn't explain the absence of Nakamura and Alexandrov. He put the question aside and turned back to his meal. He took a long look at it, then in disgust he picked up the half-finished meal and threw it in the trash. Thank God, he thought, the supply ship is due in thirty-six hours.

He headed for the shops where the probes were overhauled. Two probes were in handling cradles at the moment. The station's artificers were busy removing and replacing the experiments which had been deleted

from the schedule for these probes.

He looked beyond the probes, at the huge viewport in the end wall of the shop. Ordinarily the thick glass window was shuttered both inside and out. The shutters were opened only when there were workers outside, on the probe launcher.

He saw two space-suited figures clambering over the launcher. No reports of trouble had reached him, so he assumed this was a routine pre-launch checkout.

He then stood and watched the stars as they wheeled slowly past the port. Ever since childhood, when he'd gone on camping trips with his parents, the stars had fascinated him. In the wilderness, away from city lights, the stars looked so close he felt he could almost reach up and touch them. He remembered thinking that if he could just grow a little taller, the stars would be within his grasp. It was an acute disappointment to him when he learned that Einstein had put them forever out of reach.

The anomaly of the stars outside the viewport had amazed him ever since he arrived at the station. He told himself he saw the stars more often from his backyard on Earth than he did from the interior of this station in space. That was inevitable. The integrity of the structure required that it be built with an absolute minimum of hatches and ports.

The stars, in their stately dance, now seemed distant, cold, remote. If Kuntz was right, they would stay distant and remote. He hoped Kuntz was wrong.

He shook his head, to break the

train of thought about Kuntz, then approached Nick Vlahos, the shop foreman. "Nick, I'm sorry to put this extra workload on your people. I tried to make as few changes in the loadings for these two probes as possible."

"Don't worry, Hal. We'll meet the launch schedule for them."

"Thanks. The next several probes to be loaded shouldn't pose any unusual problems. You haven't started on them yet, so there's nothing to be undone. You have the latest schedule?"

"I downloaded it from the bulletin board just a few minutes ago. Do you figure on any more changes?"

"Not if I can help it."

"Good."

Just then the intercom beeped. "Excuse me," Vlahos said.

The voice was John Foglio's. It sounded strangled, as though he were shouting and it overloaded the amplifier.

"Nick, is Hal Morton up there?"

Morton stepped to the intercom. "I'm here, John."

The relief in Foglio's voice was palpable. "What're you doing there? I've been calling all over the station for you. Come quick!"

"Come where? Where are you?"

"Sam Nakamura's quarters. He's ... he's dead."

Morton was panting as he reached the cubicle where Nakamura lived. Correction. Had lived. Yussuf Abbas, the station's medic, was already there. Foglio and Alexandrov were standing just inside the hatchway.

"John, what's happened here?"

"I got a call from Alexandrov," he nodded in the pilot's direction, "that there was something wrong with Nakamura."

Alexandrov broke in. "When he didn't show up for our chess game, I came to his quarters. I knocked, but got no answer. The door was unlocked, so I went in. I found him like that." He pointed to where Nakamura was slumped over his desk, apparently asleep.

Foglio spoke up. "When I got here, I immediately called Doc Abbas. Neither Alexandrov nor I touched anything between the time I got here and Doc arrived."

"What's the story, Doc?"

"He was dead when I arrived. Body temperature was almost normal, so he hadn't been dead long. However, I don't see any immediate cause of death. No external trauma, anyway. I'll want to run an autopsy before I can say anything for sure."

"Any indication of disease?" The threat of an epidemic on an isolated space station weighed heavily on the minds of all spacefarers. "Any indication I should quarantine the station? Or delay the docking of the supply ship?"

"At this point, no. I hope to have an answer for you in an hour or two."

Two of the station's maintenance crew showed up wearing isolation suits. They zipped the body in an isolation bag, put it on a stretcher, and hauled it off toward the sick bay.

As Abbas followed the body out the hatch, Morton turned to Alexandrov. "Mikhail, you've spent a lot of time in here. Do you notice anything out of

place? Any sign that someone disturbed something?"

Foglio spoke up. "If you're thinking of foul play, and looking for a suspect, I suggest that Mikhail himself will have to establish an alibi. The mere fact that he visits Nakamura so often is going to make people think of him first."

"Surely you can't think our chess rivalry would bring me to kill Sam!"

"Right now I'm not thinking anything. I'm simply pointing out how people's minds will work."

"You have a good point, John," Morton said, "but we can't restrict it to Mikhail. Ask everyone on the station to send me a message detailing their whereabouts for the past four hours, and listing anyone who was there at the same time."

"Sounds like a good idea. I'll get right on it." He walked out at a brisk clip.

"Hal," Alexandrov spoke, "here's something I've never seen before."

He pointed at a black plastic cube, about two centimeters on a side, sitting on a bookshelf over Nakamura's desk. He reached out toward it. Morton grabbed his wrist. "Don't touch. Fingerprints."

"Is there anyone on the station who knows how to take and match fingerprints?"

Morton sighed. "Probably not. I guess I've read too many mystery novels. Right now there aren't any cops within something like 200 million kilometers. Just the same, don't do anything that might destroy evidence."

He leaned forward to take a closer

look at the cube. Upon close examination it looked as though it had been baked. The surface had a scorched, dessicated appearance, with flecks of light brown appearing on what had apparently once been dark black. Other than that, the cube was entirely featureless.

"You sure you've never seen that before?"

"Not absolutely sure, no. It's so inconspicuous I could easily have overlooked it. But I don't remember it."

Morton took a pencil and pushed the cube slightly. He couldn't detect any scorch marks on the paint of the metal shelf. Evidently if the cube had been heated, the heating had happened somewhere else.

"OK, let's lock this place up, and wait for Doc Abbas's findings." He shut and locked the door behind him, went to Nakamura's work cubicle and locked it, then headed for his office.

Morton leaned back in his chair and placed his hands over his eyes. He told himself he needed sleep badly, but that had to wait. He had a cluster analysis program analyzing the messages people had sent him with what amounted to their alibis. He reminded himself, though, that unless and until Doc Abbas found evidence of foul play, "alibi" was an unwarrantedly provocative word.

The printer started to hum. He reached for it, to start yanking the pages out one by one, when the intercom beeped.

"Morton here."

"Abbas calling, Hal. I've completed my autopsy."

"What'd you find?"

"Nothing. No wounds, no traces of poison, no signs of any disease. It was like he just quit living. He looks like any other case of natural death I've ever autopsied. It's just that I've never seen anyone as young as he was die without a reason. If he died of anything other than natural causes, though, it's too subtle for me to detect. Of course, I'm not properly set up to do forensic medicine."

"Yeah. No one ever expected we might have to investigate the possibility of a murder on this expedition. OK, put him back together and freeze him. We'll send him back on the supply ship."

He flicked off the intercom and retrieved his results from the printer. What was he expecting, he asked himself? Did he really want to find that someone stuck out like a sore thumb, not having an alibi for the time before Nakamura's death? No, in all honesty, he wanted to believe that Sam had died naturally. Therefore he wanted everyone to have an alibi.

Most did. Their presence was accounted for the whole time, and verified by others. Some had confirmation of their whereabouts for most of the time, with only short gaps. A few of the scientists claimed to have been in their work cubicles with no witnesses. Some of the support staff who worked second or third shift claimed to have been asleep in their quarters.

Put the sleepers and the scientists at work aside for later. Could there be a conspiracy, with its members vouching for each other? If so, the analysis should show a cluster of peo-

ple who had no confirming witnesses outside the cluster. No such cluster showed up. Ergo, no conspiracy. If there had been foul play, it had involved some lone individual.

What about those who claimed to be working alone? A thought struck him. Probably all the scientists on the station switched on their computers immediately after they switched on their lights when they entered their work cubicles. If he checked the time-stamp on their work files, could he verify whether they'd actually been working?

He logged off as Hal Morton, research scientist, and logged back on as Hal Morton, system operator. He was the only person on the station with two separate identities in the computer. As SysOp, he had access to everyone's files. A quick check confirmed the stories of those who claimed to have been at work in their cubicles. They each had plenty of files, including backups, with time-stamps which put them in their cubicles at the times they said they were there. Morton's motto for computer users, "Save early and often," was intended to protect against lost work. This time, it also provided an alibi.

That left only the sleepers, a thought which reminded him how badly he needed sleep. He suddenly realized he'd never reported Nakamura's death to headquarters. Well, that was easily done. He composed a message, put it in the queue to be transmitted back to Earth, and shut things down. Then he headed for his quarters.

* * *

Groggily Morton groped for the alarm and shut it off. He thought to himself, he had a whole day to get through before he could get back into bed. He dragged himself to the lounge, forced himself to eat some breakfast, and headed for his work cubicle.

John Foglio was waiting for him. "Should I start packing Nakamura's personal effects, to be shipped back with his body?"

"Yeah, those have to go on today's supply ship, don't they? Better do it. But check every data disk in his quarters, to verify it's personal and not somebody's experimental data."

As Foglio walked out, another thought struck Morton. He'd better check through Nakamura's computer files. Personal files could be downloaded and sent back with the body. Work files had to be identified and transferred to the researchers who needed them. That was a job for the SysOp.

As he logged on, he got a "hacker alert." While he never wanted to believe that scientists would deliberately sabotage each other's work, he knew that the researchers on the station included people who ranked near the top of the human race in their knowledge of computer software and hardware. They could be very effective hackers if they ever put their minds to it. Their hacking would most likely be limited to practical jokes like having a printer stream out several meters of paper printed with HAPPY BIRTHDAY when the owner turned it on. Nevertheless, even such apparently harmless pranks could

crash the whole system.

To nip any hacking in the bud, Morton had set a number of traps in the computer's operating system. Some of them were fairly obvious; some weren't. The unobvious ones revealed that the obvious ones had been bypassed. Not only bypassed easily, but bypassed contemptuously, as though the hacker never dreamed the obvious traps were intended to be found, it discouraged looking for the unobvious ones. Whoever had done it thought himself to be a lot cleverer than he actually was. Or was that itself part of the cleverness? Was the hacker really trying to lull Morton into believing his opponent was inept? Never underestimate an opponent, Morton told himself.

But what, if anything, did the hacking have to do with Nakamura's death? He called up the records left by the hacker trap. The hacker had logged on during the third shift, while Morton was asleep. He had logged on using Nakamura's password. And he'd logged on using Nakamura's computer, from inside Nakamura's supposedly locked work cubicle. All of a sudden, the idea that Nakamura had died of natural causes seemed very, very unlikely.

The first step was to determine what the hacker had done. Since he'd pretended to be Nakamura, the obvious place to look was Nakamura's files. As the station's data analyst, Nakamura had a huge collection of work files. There was no way Morton could search through all those in a hurry. He found, though, that each work file was identified with the name of the

researcher whose data it was. He decided to copy the files to the appropriate researchers, and ask them to check for any tampering.

As he completed that task, something struck him. There were no files dealing with Kuntz. Not only were there no files containing Nakamura's analysis of Kuntz's model, the file with the derivation of Kuntz's space-time model was missing from Nakamura's directories.

Erasing some of Nakamura's files didn't require any hacking, except that needed to steal Nakamura's password. And, Morton thought, if Nakamura was as cavalier about computer security as most scientists were, his password was written down somewhere within easy reach of his keyboard. Since the hacker had logged on from inside Nakamura's work cubicle, there was probably no mystery about how the password was stolen. So, how had the hacker trap been tripped? What had the hacker been doing which took him outside of Nakamura's allocated file space?

Answering that turned out to be straightforward. The hacker had tried to erase some of Nakamura's backup files stored in write-once memory. Trying that was a waste of time. Those files could be erased only by physical destruction of the recording medium. Why didn't the hacker know that? Maybe he wasn't a very smart opponent. On the other hand, Morton now had to assume that whoever the hacker was, he had managed to kill Nakamura without leaving a trace of his method, and while maintaining an alibi. Besides that, he had managed

to enter a locked compartment. That implied someone pretty competent.

Well, if those files were important, Morton decided he'd better read them.

Nakamura's backup files turned out to be as well organized as his work files. Morton quickly found the ones related to Kuntz. He copied them to his own work space. On second thought, he downloaded them to his own computer and erased them from his work space. That way if the hacker managed to penetrate Morton's work space, there would be no sign Nakamura's files had ever been resurrected.

He started with the oldest. This turned out to contain the fitting of Kuntz's model to part of the solar equatorial data. The next file contained the results of comparing the fitted model to the other half of the data. The third file contained an analysis of the model fitting process. The average error of the fit seemed acceptably small. No wonder Kuntz was happy with the results, and Nakamura satisfied they were correct.

The next file was time-stamped late yesterday afternoon. The file contained a plot comparing measured data with that predicted from Kuntz's theory, as a function of position along the probe's orbit. This must have been one of the special analyses Nakamura had volunteered to do for Kuntz, and it was clearly based on data from the probe recovered yesterday. Morton decided the plot had something peculiar about it. Ordinarily he'd expect the measured data points to be randomly scattered

about the predicted curve. For most of the orbit, that seemed to be the case, with the possible caveat that there seemed to be more of the points below the curve than above it. At perihelion, though, the data lay well above the predicted curve. There was a symmetrical peak in the data as the probe went through perihelion. The average fit was good, as Kuntz had hoped it would be. But that average hid a systematic deviation. *As Kuntz had known it would?*

Stunned, Morton sat back in the chair. Had Kuntz originally asked Nakamura for analyses which he knew would falsely validate his new theory? He would have had a good chance of getting away with it. A published paper, which included Nakamura's analysis, would most likely to be taken as definitive. Probably no one would ever retrieve the original data and repeat the analysis. After all, you don't win the Nobel prize for replicating someone else's successful experiment, much less for checking someone else's mathematics. Besides, it might be another generation before another expedition collected systematic data on the Sun's gravity field. Kuntz would be safely dead by then.

But why would Kuntz do such a thing? What did he have to gain? Even if he won the Nobel prize, what satisfaction would it be to him, knowing that his "discovery" was a lie? And what additional motivation could he have had for killing Nakamura? Even if Kuntz's theory went down the drain before it was even published, this wouldn't hurt his career in the least. It was no dishonor to advance a the-

ory and find that it failed a rigorous test. Regardless of the absurdity of the idea, though, Kuntz was now the prime suspect for the murder of Nakamura, not to mention hacking into Nakamura's work space.

He found another file, time-stamped a few hours after he'd given Nakamura the copy of Kuntz's derivation. He opened it.

FROM: SAM NAKAMURA

UN MERCURY RESEARCH STATION

SNAK@UNMRS.SPACENET

TO: REFERENCE LIBRARIAN

UNIVERSITY OF CALIFORNIA AT LOS
ANGELES

REFLIB@UCLA.INTERNET.USA.EARTH

PLEASE UPLOAD A COPY OF "ON AN INTEGRAL ON A CLOSED PATH ON A RIEMANNIAN SURFACE," BY ALEXANDER GORSHKOV, FROM JOURNAL OF COMPUTATIONAL TOPOLOGY, VOL. 3, NO. 2, JUNE 2007, PP. 147-196. REFER TO PURCHASE ORDER NUMBER UNMRS27-3301.2.

THANK YOU.

Another file contained the answering message, time-stamped slightly over three hours after the first one.

FROM: REFERENCE LIBRARY

UNIVERSITY OF CALIFORNIA AT LOS
ANGELES

REFLIB@UCLA.INTERNET.USA.EARTH

TO: SAM NAKAMURA

UN MERCURY RESEARCH STATION
SNAK@UNMRS.SPACENET

THE JOURNAL CONTAINING YOUR REQUESTED ARTICLE WAS PUBLISHED FROM 2003 TO 2011 BY A SCHOOL OF TOPOLOGISTS AT PETROGRAD UNIVERSITY. BECAUSE OF ITS SMALL CIRCULATION, IT WAS NEVER ENTERED INTO THE GLOBAL COMPUTER DA-

TABASE. WE HAVE LOCATED HARD COPIES IN THE ARCHIVES AT PETROGRAD UNIVERSITY. WE REQUESTED THE LIBRARY THERE TO SCAN THE HARD COPY FOR YOU AND UPLOAD IT. THEY HAVE CONFIRMED THEY WILL DO SO. PLEASE ADVISE IF YOU HAVE NOT RECEIVED IT WITHIN 12 HOURS.
THANK YOU FOR YOUR PATRONAGE.

He scanned through the directory, to see if the reply was there. No. Every file was clearly something else. Had the article ever been received? And did it matter? Sam certainly didn't need it any longer.

Wait. All incoming and outgoing message traffic was stored in a backup directory, as well as being routed to the addressee. The backup copies were purged automatically after a week, but the message should still be there if it had been received since yesterday.

He switched directories and let the headers on the messages scroll up the screen. There it was! And time-stamped less than four hours after the message from UCLA. Evidently the folks at Petrograd had moved fast.

But wait! The hacker had wiped the article out of Nakamura's files. Sam had never made a copy in write-once memory. That meant it had arrived *after Sam was dead*. He noted the time-stamp on the article. He switched back to Nakamura's back-up files. The latest time-stamp on any file there had to be a time when Sam was still alive. That time-stamp put Sam's death, at most, three hours before the body was discovered.

He gave himself a mental kick in the pants. When had the hacker traps

been tripped? He rechecked them. Yes, they had been tripped only half an hour after the time-stamp on the Gorshkov article. So whoever it was had killed Sam, then later entered Sam's locked office, hacked his way into Sam's files, probably using a stolen password, then erased not only the files Sam had stored but the incoming message, which Sam had never seen.

OK, now that he had the information, what could he do with it? Was there some way to connect all this to Kuntz? Or alternatively, to prove it wasn't Kuntz but someone else?

Alexandrov was right. There was no one on the station, and certainly not him, who knew how to conduct a murder investigation. There wasn't a trained cop within millions of kilometers. Were there any military police on the Space Service ships? Even if there were, they were probably more used to standing guard over the ship's armory, and calming over-exuberant spacemen on ground leave, than they were to investigating a murder. And in any case, they had no jurisdiction over the research station.

Morton's train of thought was broken by the *beep* of the intercom. It was John Foglio.

"Chief, I've just received a message from the commander of that Space Service task force. I've encrypted the original in the files and I'm bringing you a copy."

Morton stared at the intercom. Why the mystery? Why not just send him a copy? And why bother encrypting the archive copy?

Foglio was panting as he strode

through the hatch and handed the printout to Morton.

FROM: COMMANDER, TASK FORCE MERCURY
CC/TFM@ONIZUKA.UNNET.SPACENET

TO: JOHN FOGLIO

UN MERCURY RESEARCH STATION

JFOG@UNMRS.SPACENET

1. PICKET SHIP ORION HAS RECOVERED A DERELICT SPACECRAFT WELL INSIDE THE ORBIT OF MERCURY. IT WAS IN AN ORBIT WHICH WOULD HAVE DECAYED INTO THE SUN WITHIN THREE TO FOUR DAYS. IT WAS FIRST THOUGHT TO BE A TARGET DRONE WHICH HAD GONE OFF COURSE. MARKINGS ON IT INDICATE INSTEAD THAT IT MAY BE ONE OF YOUR PROBES.
2. PORTIONS OF THE SPACECRAFT APPEAR TO HAVE BEEN SUBJECTED TO INTENSE HEAT. OTHER PORTIONS APPEAR UNDAMAGED. A VIDEO IMAGE IS ENCLOSED.
3. DO YOU WISH US TO RETRIEVE THE SPACECRAFT FOR YOU?

Morton looked at Foglio. "Where's the picture they said they were sending?"

Wordlessly, Foglio handed over a facsimile image.

"It sure looks like one of our probes, but the solar panels have been removed."

"Yes," Foglio replied, "and look where the damage is."

Morton examined the image closely. "I see what you mean. The instrument bay and the recorder bay have been wrecked. The rest of the probe seems undamaged."

"How come we didn't spot the probe ourselves, even though it was damaged? Even without the beacon operating, it should have given a recognizable radar echo."

"Based on the apparent location and time of its discovery, it came by earlier than we expected. We weren't looking for it yet. If it was in a decaying orbit, as the message says, it would have been early rather than late. Something happened to it while it was on the other side of the Sun, hidden from us; something to wreck it and put it in a lower and faster orbit."

"Is it possible the probe went through a solar prominence and part of it got melted?"

"No. While the gas temperature in a solar prominence is high, the density is actually very low. You couldn't warm a cup of tea with it, let alone melt a solar probe this way."

"If you rule out natural causes, then this had to be someone's doing. Do you suppose some of the Space Service people mistook it for a target drone?"

"Let's give Alexandrov a look at it."

Morton called the pilot on the intercom, then waited impatiently for his arrival.

"Mikhail, does this look like the kind of damage which might be done by Space Service weapons?"

"Nothing I ever trained with. Our missiles would have blown holes in it, not melted it. And here," he pointed at the picture, "look at the stubs where the solar panels were mounted. Those were sliced off clean. We don't have anything which would do that, at least not from long range."

"Well, whoever did it sure knew what they were doing. They wiped out the data it was carrying."

Somehow, Morton felt, this destruction of the probe was connected with Nakamura's death and Kuntz's fabrication of a theory of space-time. The feeling was as strong as any hunch he'd ever had about a possible experiment. But how to convert it into a testable hypothesis?

He came to a quick conclusion. "John, send a message back to the task force commander asking him to retrieve the probe for us. However, don't say a word to anyone on the station about this. Since the data recordings on the probe were destroyed, it doesn't change our revised schedule, so keeping it secret doesn't harm our operations. I suspect there's someone on the station who already knew about the destruction of the probe. I don't want him to know he's been found out.

"Next, I want you to fake an intense solar flare. Put a flare image on the video and jimmy the radiation counters, to look like a flare so intense everyone has to take shelter in the storm cellar. Can you do that, John?"

Foglio gave him a puzzled stare. "Yeah, I can. I don't see why, but I'll do it."

After Foglio had gone, Morton turned to Alexandrov.

"Mikhail, I'd like to go to your quarters, immediately."

Alexandrov unlocked his door, gestured Morton to step inside, then closed the door behind him.

"Mikhail, this may sound like a strange question, but it's important. Do you have a gun with you?"

Alexandrov stood silently for a long moment, then went to a closet.

He dragged out several boxes, then pulled a small box from behind another one. He opened it, dumped a roll of cloth on the bed, then began unwrapping it. Out of the wrapping fell a black-colored gun.

"So you do have one. Good. But it's strange-looking. I've never seen a gun with the grip at right angles to the frame. Nor with that rounded back on the frame."

"It's a Tokarev 9-millimeter. It's nearly a century old. My grandfather carried it during the Great Patriotic War."

"Does it still work?"

"Yes." Alexandrov grinned. "Very well, indeed. The year before I resigned my commission, I placed third in the all-Service pistol matches using it."

"If a bullet from it hits the skin of the station, will it punch a hole through it?"

Alexandrov pulled a box of ammunition out of the wrapping. "This is what the Space Service uses during breaching and boarding operations. The projectile is made up of small lead shot cemented together with epoxy. The projectile breaks into separate pellets when it hits anything. The shot won't penetrate the station skin. They will tear up unprotected human flesh pretty badly, though, even through a space suit."

"OK, load it, find some way to hide it, and take it with you." They headed for Morton's office.

Morton closed the door to his office, then checked the intercom to make sure it was shut off.

"Hal, can you tell me what's going on here?"

Morton slumped in a chair. "I'm not entirely sure myself, Mikhail, but I have some strong hunches." He quickly outlined the sequence of events he'd discovered from examining Nakamura's files. "My hunch is that Kuntz is the killer, as well as the computer hacker. And somehow, this shot-up solar probe is connected with Sam's killing. But I can't give a logical explanation for it yet."

"Do you know whether Nakamura showed Kuntz the results of his analysis of the new data, the one showing the big deviation from Kuntz's theory?"

"I knew he had time to do that, since he completed the analysis before he was killed. But I can't prove Kuntz ever saw it."

"Let's assume he did show Kuntz the analysis. How would killing Sam make sense for Kuntz?"

"That's what I've been trying to figure out. Having your theory disproven isn't grounds for killing someone."

"Maybe so, Hal. You're the scientist, not me. But what about the solar polar probe. What if we'd recovered the data from it? How would that fit in?"

Morton sat erect and snapped his fingers. "The solar polar probe would have collected data over the Sun's poles, at much higher gravity fields than any other experiments we've run. If there was a discrepancy between Kuntz's theory and the data taken at perihelion on an equatorial orbit, there would be an even bigger

discrepancy with the polar data.”

“Now we’re getting somewhere,” Alexandrov said. “Do you suppose someone destroyed the probe to keep us from learning that Kuntz’s theory was wrong?”

“But we don’t need the data from the polar probe to prove that. We knew it already from the equatorial probe.”

“Wait, Hal. We knew it from the equatorial probe only because Sam did more than he had to. He ran some additional analyses, beyond what Kuntz had asked for. If Sam hadn’t done that, Kuntz’s original analysis would have showed that his new theory was correct.”

Morton stood up and started pacing. “You’re right. And there’s more. Yesterday Sam showed me a mathematical joke that I’d never seen before. It was based on sneaking a false assumption into a proof, so you could get an absurd result. He told me Kuntz had become upset when he showed it to him.”

“There’s part of your answer, Hal. Kuntz somehow deliberately faked a theory, with phony math to back it up. In all innocence, Sam showed him that mathematical joke, then later showed him the analysis that proved his theory was wrong. Kuntz might have concluded that Sam knew there was something phony with the math, that it wasn’t an honest mistake. So Kuntz killed him to cover it up.”

“It still doesn’t fit, Mikhail, unless...” He stopped pacing and stared at a blank wall, his mouth hanging open and the sentence unfinished.

“Unless what, Hal?”

“Unless the derivation of Kuntz’s theory had a false assumption built into it somewhere, and Kuntz knew that. But where... Of course!” He began pacing again.

“Of course what, Hal? You’ve lost me.”

“Sorry, Mikhail. Kuntz’s results depended on something called Gorshkov’s Theorem, which was published in a thirty-year-old article in an obscure journal. Ordinarily no one would question that. I didn’t. When I was examining Kuntz’s derivation I just noted the citation and went on. But Sam went to the trouble of ordering a copy of the original article.”

“That really must have put the fear of God into Kuntz. What did you call it? Gorshkov’s Theorem? Suppose that was phony, and Kuntz knew it. He must have concluded that Sam’s joke was a subtle way of telling him he’d found out.”

“But blast it, Mikhail, that still doesn’t tie in the destruction of the probe. I’m not ready to believe a conspiracy so big that it could publish a faked proof in a scientific journal, then thirty years later derive a theory using that proof, and secretly send out a spaceship to destroy the very probe whose data could disprove the theory. That’s too much to swallow.”

They were interrupted by a *beep* from the intercom. The **OVERRIDE** light blinked on, then Foglio’s voice came through the speaker.

“Attention all station personnel. Flare alert. A flare is developing below us. Probability of flare now 90 percent. Estimated time to eruption

less than twenty minutes. All personnel begin an orderly shut-down of equipment and operations, and report to the storm cellar next to the shuttle dock. Repeat. Flare alert. Shut down all operations and report to the storm cellar. This will be your only warning."

Morton switched on a video display. It showed a sunspot with the angriest appearance he'd seen since the start of the expedition.

"That really looks like a nasty one," Alexandrov said.

"Yes, it does. Now let's get busy. First stop, the probe overhaul shop."

Minutes later they were hiding in an equipment closet a few meters from the door to Kuntz's quarters. Morton was clutching the laser drill and fiber-optic inspection scope he'd picked up at the overhaul shop. Through the door they could hear the muffled sounds coming over the intercom.

"Level one, quadrant A clear."

"Very well. Report to the storm cellar."

"Level two, quadrant A clear."

"Level one, quadrant B clear."

The roll call went on, as the designated searchers cleared each sector of the station. They heard footsteps in the corridor outside. Someone rattled the door to the closet, found it locked, and went on. The footsteps faded out.

After a few minutes, Morton spoke.

"I think the coast is clear now. Let's get started."

He opened the closet door a crack, looked down the hallway, and found

it to be empty. He pushed the door wide open and stepped out.

Foglio's voice blared over the intercom. "Alexandrov and Morton. Report to the storm cellar immediately. The flare is nearly ready to erupt."

They padded down the hallway to Kuntz's compartment. Again the intercom blared.

"Hal, for God's sake get up here to the storm cellar! Mikhail! The radiation level is already above the limit for the station's armor! It's going to be at lethal levels within a few minutes."

Silently they approached the door to Kuntz's compartment. Morton measured carefully from the edge of the door frame, put the laser drill against the wall, and pressed the switch. He pulled the drill away and grunted with satisfaction at the tiny hole in the compartment wall.

Foglio's voice came again. "No! Keep that hatch closed! Don't try to go looking for them. Look at the radiation count on the meter. The radiation level out there is too high. You'd get a lethal dose before you got halfway down to the main level."

Calmly, Morton put the fish-eye lens of the inspection scope through the hole he'd drilled, then looked through the eyepiece at the other end of the optical fiber.

"Room looks empty. If Kuntz weren't in the storm cellar, John would be calling for him, too. I guess it's safe to go in. Hey! There's what looks like one of those black cubes, like we found in Nakamura's quarters sitting on a table in the middle of the room. Only this one's got shiny sur-

faces. If we can connect Kuntz with the cube that was in Nakamura's quarters, that would prove something."

"Only that Kuntz had visited Sam, and we already knew that."

"But for an ordinary visit he wouldn't have left one of those cubes."

"Maybe not, Hal, but I don't think it's a very strong link."

"It may be the only link we have." He pulled a set of master keys out of his pocket.

Alexandrov grabbed his arm. "Wait. The Space Service drilled me on this pretty thoroughly. If a room is occupied, you blow the door in and move in quickly, before the people in the room can react. If a room isn't occupied, you open the door slowly, stay out of the doorway, and wait at least thirty seconds before entering. That gives any booby-traps in there time to go off."

"OK. Makes sense to me." He turned the key in the lock, stepped aside, and gave the door a push inward.

Pain! Nausea! Blackness closing in!

Morton found himself slumping against the corridor wall. He caught himself before he fell completely to the floor.

"God in heaven!" Alexandrov gasped. "What was that?"

"I think that was what killed Sam. Only he got the full force of it. We got only what leaked around the door frame. Are you OK?"

"I think so. I'll certainly want Doc Abbas to look me over, though."

"Look!" Morton pointed through

the doorway. "See that cube on the table? It has the same desiccated look the one in Sam's quarters had. But when I looked through the wall with the inspection scope, it had shiny black surfaces."

"Evidently it's something like a grenade, and when it goes off, whatever energy it puts out cooks the surface."

"Does the Space Service have anything like that?"

"Not that they ever showed me."

Foglio's voice screamed over the intercom again. "Dr. Kuntz! No! Don't open that hatch! Someone stop him! No! Don't follow him! The radiation will kill you, too! Get that hatch shut quickly!"

Morton looked at Alexandrov. "Kuntz must have had some kind of alarm to let him know when the booby-trap was sprung. He must realize the flare alert is a fake. He'll be heading down this way."

They returned to the closet, leaving the door open a crack so they could see the entrance to Kuntz's quarters. They waited. Finally Morton spoke.

"He's had ample time to come here. Where else might he have gone?"

"Can you check from your office?"

"No, but we can check all the video cameras from Foglio's office."

They ran down the corridor, up a flight of stairs, and down another corridor to John Foglio's office. A bank of video displays showed every corridor, elevator, and stairway in the station.

Alexandrov pointed. "There he is! Level three, quadrant C!" The screen

showed Kuntz's image as he fumbled with the door to a compartment.

"That's the main computer room. The write-once memories are located there. He must be after them!"

Morton dashed out of the office, along a corridor, up one stair, and down another. He and Alexandrov burst around a corner. Kuntz was standing at the door to the computer room. He was holding a small object near the lock. A spot on the door glowed red, then white, and a stream of metal trickled down the door.

Morton ran forward. "Stop! Don't try to open that door!"

Kuntz turned, brought the object up, and started to point it at Morton.

Bang!

The report from behind Morton echoed through the corridor. The reek of smokeless powder filled the air. Kuntz's arm hung at an odd angle, and the object dropped from his hand, clattering on the floor.

Alexandrov stepped around Morton, keeping his pistol trained on Kuntz. "Surrender, or the next shot will be intended to kill."

Morton stared at where the shot had struck Kuntz's arm. A patch of deep ultramarine slowly spread around the tear in his shirtsleeve, and started to drip on the floor.

"My God! That isn't human blood!"

In his mind's eye, the walls of the station fell away, and the stars crowded in, no longer distant and remote. Somewhere out there, *they* were watching. *They* had planted Kuntz on his station. *They* had destroyed his solar probe. And right now *they* might be planning to rescue

Kuntz and destroy the research station.

Recovering himself, he stepped to an intercom on the wall.

"John Foglio. Cancel the flare alert and radiation alarm. Bring Doc Abbas down to the computer room. Tell him he's about to have the most unusual patient in his entire career. Oh yes, bring along a couple of husky mechanics from Vlahos's gang, as well. Tell them to get some crowbars or something like that, to use as clubs."

Minutes later, Abbas was ripping off Kuntz's shirtsleeve and applying a bandage. Two sturdy-looking machinists stood behind Kuntz.

Alexandrov spoke to Foglio. "Send a message to the Space Service task force commander. Just two words: 'Broken Arrow.' And sign it 'Lieutenant Commander Mikhail Alexandrov, UNSS Reserve.'"

"Is that a code?"

"Yes. It means we've captured an extraterrestrial. Just in case Kuntz's friends are monitoring our radio transmissions, I want to keep them in the dark as long as possible. The Service has prepared a standard procedure for the first time we encounter an alien. We've never tested it, of course." He frowned. "I hope it works."

John Foglio stepped into Morton's office. "Chief, you have some visitors. This is Admiral Imai Toshikawa, commander of the Space Service task force, and Captain John Mbene."

Morton stood up and extended his hand. "Good day, gentlemen. I'm cer-

tainly grateful you moved your ships to surround this station. I've had visions of a faster-than-light ship racing in here, shooting up the station, and recovering Kuntz, or whatever his real name is."

Admiral Toshikawa spoke. "We have seen some anomalous radar returns which might be interpreted as a faster-than-light ship passing by us. If it was such a ship, however, it made no attempt to attack us.

"In any case, we will be leaving for Earth shortly, taking Dr. Kuntz with us. That should remove any threat of attack on your station."

"You have Kuntz under guard?"

"Yes, he is in the brig, and a squad of Marines is constantly guarding him. He will not escape."

"We're transmitting all our data back to Earth as fast as we can upload it. That too should reduce the threat to us, since attacking this station won't destroy the data."

"Dr. Morton," Mbene spoke up. "I'd like to discuss the significance of your data with you."

"Yes," Toshikawa added. "Captain Mbene is my staff intelligence officer. My primary reason for coming here was to let him talk with you."

Morton gestured to some chairs. "Please be seated, then. I'll be glad to answer any questions I can."

Mbene spoke up. "It's clear that Kuntz was a spy. He hasn't given us any information about his origin. Once we removed his disguise, though, it was obvious he wasn't human. What we would like to know is, what was his mission here?"

"I assure you, Captain, he didn't

confide in me."

"I hadn't assumed he did. However, I think we can infer it from his actions. As I understand it, he was planning to publish some kind of false theory, attempting to support it with data you had collected."

"That seems to be the case. He came in here with a theory he claimed he was developing. We supplied him with data we had already collected. It seemed to verify his theory."

"Wasn't there something about new data as well?"

"Yes, we recovered a probe within the past two days. It had some data taken in more intense gravity fields than the data he used to calibrate his theory."

"Did that data fit his theory?"

"According to the analysis methods he wanted to use, it would have supported the theory. Unfortunately for him, Dr. Nakamura used a more powerful analysis method which showed that the theory didn't hold at more intense gravity fields." His face twisted into a grimace. "It was also unfortunate for Dr. Nakamura."

"Yes, we are aware of that. But what is the significance of his theory, and its failure?"

"Well, he was evidently attempting to convince us that faster-than-light travel was impossible. Of course, that was the conclusion we had already drawn from the general relativity theory. Since we knew that general relativity was a limiting case, valid only at moderate gravity fields, and would have to be modified, in principle the question of faster-than-light travel

was open again.

"Now, why was he trying to do that? I'd say it's almost certain Kuntz is from some other solar system, not this one. We know enough about the outer planets to be confident of that. That leaves the question of how he got here. His home world might be close enough that he could have arrived at sub-light speed in less than a lifetime. Or he might have been born on a generation ship which had left his home world before he was born."

Mbene spoke. "It is also possible that his people reached our Solar System years ago, on a sub-light vessel, and have been infiltrating us ever since."

"But that's just the point." Morton stabbed his finger at Mbene. "If they had arrived using sub-light vessels, why would they be so determined to convince us that faster-than-light travel was impossible? Why would they have concocted a false theory of space-time that reinforced that conclusion?"

"If they arrived using sub-light vessels, whether from a nearby star or on a generation ship, they would be convinced themselves that faster-than-light travel was impossible. They would be satisfied that the data we collected here, and any valid theories we developed from it, would lead us to that same conclusion. They wouldn't need to give us a false theory to convince us of what they already thought to be true.

"No, their whole effort to mislead us makes sense only if they have faster-than-light travel themselves, and are trying to keep us from getting it."

Mbene paused for a moment. "Your hypothesis is plausible, and does fit with everything we know. But suppose Kuntz had not presented a false theory. What would have been the outcome from your research here?"

"I don't know what the specific outcome would have been, but we already knew, before he arrived, that we needed a new theory to replace general relativity."

Mbene leaned forward. "Now we are getting somewhere. You are telling me that if Kuntz had not intervened, in the natural course of events, someone here on the station would have developed a replacement for general relativity?"

"Probably not someone here on the station. Most of us here are experimentalists. It would have taken a theoretician to do the job. Someone back on Earth, though, would have started working on a new theory as soon as we published our data."

"If Kuntz had succeeded in getting his theory accepted, would that have forestalled anyone else from working on the problem?"

"Possibly. However, quite a few people would have checked his theory, both theoretically and empirically."

"What would an empirical check have involved?"

"For an empirical check, they'd have tested his theory against whatever data they had available."

"Would data other than what you have collected here be available?"

"Of course, but none of it would have involved the extreme condi-

tions under which our data was obtained."

"Go on. What are the implications of that?"

Morton paused for a long moment. "I guess, without our data, they'd never have been able to disprove Kuntz's theory. After all, with the data everyone had before this expedition, we couldn't even disprove general relativity."

"It was important, then, for Kuntz's people to keep you from obtaining any data which would invalidate his theory?"

"I guess you're right. Somehow they destroyed the probe which had the high-latitude data, which almost certainly would have invalidated his theory. Even without Nakamura, someone sooner or later would have used a more powerful analysis technique and shown that Kuntz's theory didn't fit the high-latitude data."

Toshikawa interrupted. "We intend to take your probe back to Earth with us, to have it analyzed in our weapons laboratories. We need to know more about the capabilities of their weapons. Is there anything you need from it before we leave?"

"Yes, we'd like to see if any of the recorders survived. Other than that, you're welcome to it."

"Thank you."

Mbene spoke up again. "Was that the only probe you lost?"

"No, we lost two others."

"Would they likely have collected data which contradicted Dr. Kuntz's theory?"

"I don't remember. I'll have to check what their orbits were. How-

ever, I don't think their data would have provided a critical test of Kuntz's theory. So why would they destroy those probes?"

"Perhaps they were simply trying to get you used to the idea that probes disappear, so you wouldn't be surprised when the probe with the critical data disappeared."

"If that's so, I really resent them destroying our experiments."

"Yes." Toshikawa remarked. "It amounts to an act of war."

There was an edge in Morton's voice as he replied, "So does murdering Dr. Nakamura."

Mbene asked, "Suppose they had succeeded in preventing you from collecting any data which disproved Kuntz's theory. You mentioned theoretical checks. What would they have been like?"

"For a theoretical check, they'd have gone over his derivation. Just as Dr. Nakamura and I wanted to do."

"That would have meant what?"

"Checking the algebra. Checking the individual steps. Trying alternative ways of deriving the same results." He stopped. "Wait a minute!"

"What is it?"

"Whether you're deriving a result, or checking someone else's derivation, you really never go back to fundamental principles. You always build on other people's work. Otherwise we'd made no progress at all. If some result had appeared in the literature, you usually accept it. Anyone checking Kuntz's work would probably have accepted Gorshkov's Theorem at face value."

"I'm sorry, but you've lost me."

"A critical step in Kuntz's work involved something called Gorshkov's Theorem. It was published in a journal thirty years ago, and no one ever challenged it. We'd no more question it now than we'd question one of Euclid's theorems."

"Are you telling me that someone planted a false result in a scientific journal thirty years ago, to have it ready when a false theory of gravity needed to be foisted on you?"

"I guess that is what I'm telling you. My God, that's a virus in the scientific literature. It's as bad as a virus program in a computer." He paused. "I wonder how many other paper viruses there are. Have Kuntz and his nasty friends riddled our scientific literature with false results like that, to hamper our scientific progress?"

"Obviously I'm unable to answer that question for you, Dr. Morton. Nevertheless, I can see its importance."

Morton spoke slowly. "It's staggering. We have a massive job ahead of us, purging our scientific literature of any Trojan Horses Kuntz's people might have planted there. Clearly we'll have to go back at least thirty years, and maybe even earlier."

"One more thing, Dr. Morton. Suppose Kuntz had gotten away with his plan. Suppose he had succeeded in getting a fraudulent theory accepted. Would it ever have been detected?"

"Eventually, yes. Scientific fraud is always detected sooner or later, because it's incompatible with the results of other research. Look at the Piltdown Man fraud. Long before it was proven that the bones were

fraudulent, it was clear that Piltdown Man was an anomaly in human evolution. He had neither ancestors or descendants. We still don't know exactly who committed the fraud, nor how it was done, but we don't need to know that to be certain it was a fraud.

"The same would be true here. Eventually some result, in some field of science, would have been incompatible with some aspect of Kuntz's theory. That would have led to a rigorous check, and the fraud would have been detected."

"Can you estimate how long that would take?"

Morton unconsciously rubbed his chin. "My best guess is ten to twenty years, at most. Maybe sooner, if something in subatomic physics turned out to hinge on Kuntz's results. That could be checked in a particle accelerator. We wouldn't need another solar gravity expedition."

Mbene stood up. "Admiral, I have obtained the information I came for. Our enemies surely would have known their fraud would eventually be discovered. It is my conclusion that they didn't concern themselves about that, because they planned to take action before that happened. They were simply buying time. If their estimates agree with Dr. Morton's, we have at most ten years to prepare to ward off their attack."

Morton spoke. "Your conclusion has quite a few leaps of logic in it, Captain. I'm not sure I'd buy a scientific theory which was that speculative."

Toshikawa responded, with a grim

smile on his face. "I agree with you, Dr. Morton, that Captain Mbene's theory is speculative. However, his job is to speculate, based on whatever information he can obtain. My job is to prepare for the worst possible outcome of his speculations. We can't afford to assume he is wrong."

Toshikawa stood up. "Thank you for your time and for the information you have given us. I will transmit Captain Mbene's conclusions to headquarters on Earth, with the rec-

ommendation that we immediately begin preparing for a possible attack."

As they left, Morton remained in his chair, too stunned to move. Once again, in his mind's eye, the walls of the station vanished. The stars not only crowded in, but glared malevolently. He hoped the Admiral was wrong. But he knew he could never again look at the night sky, not even on Earth, without feeling that he was being stalked by something just waiting to pounce. ■

(Biolog continued from page 110)
unique for an SF writer, though. A first *Analog* story appeared in the June, 1988 issue, about the tribulations of maintaining a balanced biosphere inside a Martian dome.

Stories are fought out on a computer until the ideas in her head wind up on a disk. Then her artist husband and a friend or two tell her what didn't make sense. The story in the October, 1989 *Analog* came about when realizing how horrible it must have been for the first person with an artificial heart. Her own experiences as a human guinea pig brought an inside touch to the story. For the February, 1989 issue she needed to know how kangaroo meat tasted. No one in

the local zoo knew. Editor Stan Schmidt could tell her that he had found kangaroo-tail soup tasty.

For Paula, SF is the literature of reality. Since age five her life has depended on spin-off products, such as the "Star Wars" argon laser that saved her eyesight and the moonshot glucometer that keeps tabs on her blood sugar. It's recombinant-DNA that stocks her fridge with Humulin to supersede ineffective pig extract. Science fiction keeps one riding the crest of technological advances, sometimes pointing the way for experimenters and sometimes giving ideas about how to approach a changing situation. At all times, Paula advises keeping a sense of humor. ■

THE REFERENCE LIBRARY Tom Easton

Ring of Swords, Eleanor Arnason, TOR, \$21.95, 383 pp.
(ISBN:0-312-85518-4).

The Elementals, Morgan Llywelyn, TOR, \$21.95, 300 pp.
(ISBN:0-312-86529-9).

In the Cube: A Novel of Future Boston, David Alexander Smith, TOR,
\$18.95, 286 pp. (ISBN:0-312-85448-X).

Rude Astronauts, Allen Steele, Old Earth Books (P. O. Box 19951, Baltimore, MD 21211-0951, 410-889-4080), \$13 (tp), \$85 (signed, numbered, slipcased) (+ \$3 s&h for 1 copy, \$1 for each additional), 243 pp.
(ISBN:1-882968-01-8).

Dinosaur Fantastic, Mike Resnick and Martin H. Greenberg, eds., DAW,
332 pp. (ISBN:0-88677-566-3).

Letters to Jenny, Piers Anthony, TOR, \$18.95, 288 pp.
(ISBN:0-312-85413-7).

The Hydrogen World View, Roger E. Billings, American Academy of Science (26900 East Pink Hill Road, Independence, MO 64057-3284), \$?, 174 pp. (ISBN:0-9631634-0-X).

It is a truism that the way we live—no matter what way that is—is not the only way to live. Yet a great many people cannot see this as a truism at all. To say or think it is heresy more than worthy of the stake or gibbet or gashouse shower. Capitalists cannot accept communists as having any right to live. Nor can heterosexuals accept homosexuals, Christians Muslims, blacks whites, liberals conservatives. And—of course—vice versa.

This makes life difficult, for even in a relatively homogeneous society we are surrounded by differences with

which we must come to terms in order to mate, build, trade, or—in deed—do anything worthwhile. If mating were all we cared about, life would amount to an ongoing negotiation between horny porcupines. Building, trading, and so on don't permit such a piquant image, but the point does remain: we really are obliged to negotiate around our differences in order to function in the world. When we fail, our world collapses in war. We die.

It is easy to find examples to support this point. We need look no further than the daily newspaper. It also

lies behind a great many pieces of fiction, though few authors have handled it as explicitly, intriguingly, and well as Eleanor Arnason.

The novel in question is **Ring of Swords**. Its chief protagonist is Anna, a biologist stationed on a distant world to study jellyfish-like creatures that may or may not be intelligent. Each year these "pseudosiphonophores" gather to mate despite deep wariness; for most of the year, they consume each other (not quite as prey) and their reproductive apparatus is surrounded by stinging tentacles. Like humans or porcupines, they must negotiate, using flashing lights Anna and her colleagues have learned to translate and mimic. Indeed, the humans can exchange simple messages with the creatures. Yet the creatures themselves seem to say to each other nothing more complicated than, "I am me. I intend no harm. Let me come near. Let me touch you. Let us exchange what passes for love."

Call this Arnason's statement of theme. Now look at what else is going on: Military Intelligence has arrived. So have the diplomats. So has a delegation from the hwarhath, a species of furry humanoids. Since their first meeting, humans and hwarhath have skirmished in space. Now they are negotiating.

What are they negotiating? Peace? Perhaps the humans think so. The hwarhath are more interesting, for their culture's central image is a hearthfire surrounded by a ring of swords. Women and children are sacrosanct, immune from the depredations of war. Men are banished from

hearth, home, family, and even heterosexuality because of their violent, disruptive tendencies; they are assigned the task of defense against a hostile world, against hostile others. Yet hwarhath society is now pretty well unified; they need an enemy, an honorable enemy who understands and obeys the rules of war.

Might humans qualify? Unfortunately, they do not know the rules. Their heterosexuality is unbridled, their population is massively out of control (hwarhath male homosexuality serves very nicely for birth control), and they do not respect the sanctity of women and children in war (perhaps the humans' check on population). Perhaps it would be best to exterminate them and look elsewhere for an honorable enemy.

Yet perhaps a *modus vivendi* is possible. Meet Nicholas, once a prisoner, now a translator, a turncoat, and—could it possibly be?—the hwarhath leader's lover. His existence is mortal affront to Military Intelligence, which kidnaps him in order to drain every iota of information. Since he was friendly with Anna, it also kidnaps her. Fortunately she manages to get out a message that, though the hwarhath were coming to the rescue anyway, results in her presence at the next round of negotiations on a hwarhath space station. There Arnason reveals much more about the hwarhath, including the role of their women in guiding and negotiating the cross-fertilization of hwarhath lineages.

In the end, we glimpse the possibility—or more than that—of a success-

ful conclusion to the negotiations between the human and hwarhath porcupines. Perhaps they will respect each other's differences and refrain from destroying each other. Indeed, perhaps they will even fertilize each other's cultures, and the result will be something new and grand.

What Arnason has done is to take that image of negotiating porcupines—"I am me. I intend no harm..." and use it to create a novel of military tension with very little in it of military action. The result is so immensely satisfying that I will not be a bit surprised to see *Ring of Swords* on the next round of award ballots.

Morgan Llywelyn is known as the writer of the historical fantasies *Bard* and *Lion of Ireland*, which I have neither reviewed nor read because I have only a limited appetite for "that sort of thing." On the other hand, since I try to be cautious about my prejudices, when Llywelyn's **The Elementals** show up in my mail and it did not at first glance seem to be boilerplate medievaloid rackfiller, I picked it up. And I'm glad I did.

The tale begins with a hint of a conscious, aware, resentful sea, rising to swallow a humanity that has offended it with toxic wastes. A community of craftspeople is building a boat in hope of saving themselves and their livestock, fighting off the barbarians who would slaughter them all and seize their dream. Three men and about fifty women are left when the time comes to board. A horde of desperate foemen charge toward them,

the sea washes them away, and the boat is afloat. In due time it reaches the verge of a new land, and the woman who leads the survivors turns out to have a taste and talent for communing with whatever awareness resides in water.

Who are these people? Llywelyn does not say. When did they live? In due time we realize that the era is prehistorical.

What is the new land? Only much later in her book do we realize it is Ireland.

The second segment of the novel is more identifiable. It is Crete, land of Minos and Labrys, whose intellectuals reside in a colony, called Atlantis, on the volcanic island of Thera. The protagonist is a court musician whose forebears came from the Islands of the Mist. His pushy wife craves wealth more than he, so when the chance arrives, he tries to help a slave-dealer who has brought captives from his ancestral homeland, Ireland. One of them is a mage who talks to fire. You can guess the rest.

The third segment is set in mid-nineteenth century Conway, New Hampshire, where folk steer clear of a massive rock with a malign reputation. Only Daniel Foster visits it, and he gains a sense of coming weather. Annie Murphy stumbles on the secret and learns that she has a far stronger talent than Foster for communing with the mind of the rock, the mountains, the planet itself.

The last segment is set within the next century, when ozone holes and greenhouse effect and a host of new viral diseases threaten to exterminate

all humanity. George Clement Burn-
ingfeather, half Irish and half New
Hampshire Indian, abandons his ca-
reer in a near-defunct world to go to
the nearest reservation. There he
finds an ancient shaman collecting
people with essential talents.

Essential for what? For beginning a
dialog with the elementals of water,
fire, earth, and air, for learning to re-
spect the integrity of the environ-
ment, for taking the first real steps
toward restoring the balance of na-
ture, and thereby for preserving the
human species. A very sensible goal,
and an attitude that stands out in the
mystical murk that is much of mod-
ern fantasy.

Where Llywelyn sees a world best
understood in the mystical terms fa-
miliar from mythology and fantasy, as
well as from the Gaia Hypothesis in
its strong sense, David Alexander
Smith sees a world of solid material-
ism. Yes, humanity makes a mess of
things, but the world does not get
angry and come gunning for us.
Rather, the mess becomes a major
feature of the environment in which
we must live. So then what?

His mess is the greenhouse effect,
which melted icecaps and raised sea
level just as in Llywelyn's book. But
Smith does not posit an ark full of
refugees and livestock in his very suc-
cessful SF mystery, **In the Cube**. Or
does he, really? The rising sea flooded
Boston and made it necessary to re-
place the city with a huge Cube built
out of fossilized ET spit.

Where did the fossilized ET spit
come from? A cosmic Loophole

showed up in the Solar System, and
through it came a plethora of alien
species—some of them refugees
—complete with alien technologies
and cultures. The first aliens splashed
down in Boston Harbor, thus estab-
lishing the city as Earth's hub for in-
terstellar commerce and making a
few families as filthy rich as any an-
cient Lowells and Lodges.

One of the alien species provided
the spit that turns into that miracu-
lous building material known to fu-
ture Bostonians as prock. Hence the
Cube, which in due time became the
setting for Smith's book.

Another species is the Phneri, am-
phibians with a hang-up about falling
and an eidetic memory that allows
them to reconstruct almost anything
and gives them a very peculiar psy-
chology. One Phner, Akktri, is the
sidekick for Smith's private eye, Bev-
erly O'Meara, who has a hang-up of
her own dating to when Iris Sher-
wood, City Operator, solved a crisis
by flooding the Cube's lower levels
and killing her father. It's no surprise
that when Sherwood calls, asking her
to find her missing daughter, she
wants desperately to refuse. Yet she
takes the job and soon discovers that
Diana Sherwood was kidnapped. As
O'Meara follows the trail with Akktri's eager help, we tour the city
from the halls of wealth to the dregs
of the basement to the snakeskin roof
to the city's sewage-processing diges-
tive tract (that's right—the aliens
have provided biotech on a grand
scale, so the livestock is here as well).
We see Boston as the City of Immi-
grants it has always been, a place of

vitality and violence, opportunity and opposition, assimilation and apartheid, promise and peril, hatred and hope. The only difference is the identity of the immigrants.

Smith here displays impressive imagination and talent. This book will be on the award ballots.

And I'm looking forward to his next.

Allen Steele has done a number of well-received novels—including *Orbital Decay*, *Clarke County*, *Space* and *Labyrinth of Night*. **Rude Astronauts** is his first collection, "published during Balticon 27 on the advent of my first Guest of Honor appearance at a major science fiction convention"; it is also the first title from Baltimore's Old Earth Books.

To take the third first first, Old Earth could be a comer. Publisher Michael J. Walsh (you've seen him in the dealer room if you attend cons) has managed a very respectable production job marked by a Don Maitz cover, NASA astronaut photos for the interior, good paper, and clean print. If the number of typos is a bit more than we often see, we have also seen much, much worse.

To take the first first second, *Rude Astronauts* offers several stories set in the same future universe—known variously as the near-space universe, Steele's universe, or Ralph—as *Orbital Decay*. A few others take an "alternate history" approach to the space age—for instance, "Goddard's People" supposes that the U.S. government's response to word of the German rocketry work in World War

II was to enlist Goddard to head a Manhattan-style rocket project.

The book also contains a number of non-fiction pieces written when Steele was a journalist in Worcester, Massachusetts. These suffer at times from the defects typical of journalism—error and superficiality—but when he is writing about moonwalks and SETI and other sfnal topics, he can wax quite poetic. The overall effect of the fiction-nonfiction combo is thus that of a portrait of a writer who lives and breathes the dreams of science fiction, of a future in which we reach out to the universe, embracing novelty and strangeness. Just the thing for *Analog* readers.

However, let me note this: Many of Steele's stories feel more like newspaper reports and interviews than like fiction. This can be quite effective. Yet since his fiction and his journalism tend to share a single voice so thoroughly that it can be hard to tell them apart without a scorecard, someone who has not read his novels might wonder whether Steele—for all the wealth of his imagination—has too few strings to his stylistic bow.

"Despite the constantly growing interest in dinosaurs, there has never been an anthology of original stories about them. When this lack was mentioned to the good people at DAW Books, they made up their minds to change the situation. . . ." (from the introduction). The result is **Dinosaur Fantastic**, edited by Mike Resnick and Martin H. Greenberg, twenty-five tales by Robert J. Sawyer, Robert Sheckley, Pat Cadigan, Frank

M. Robinson, Judith Tarr, John E. Stith, David Gerrold, Beth Meacham, Kevin O'Donnell, Jr., Roger MacBride Allen, and more. Here are worlds dominated by dinos, a Rome ruled by Nero but with dinos in the streets, people transforming into dinos, re-created dinos, big dinos, humongous dinos, and tiny dinies, all testifying eloquently to the powerful hold of the primordial monster, emblem of extinction and obsolescence, upon the human imagination. Sawyer's "Just Like Old Times" supposes a murderer sentenced to exile in the brain of a *Tyrannosaurus rex*. Supposedly he can exert no control, but he sees all those little furry ancestors of his future kind, and . . . Allen's "Evolving Conspiracy" presents a conspiracy nut who has proven God and the Cubans are in it together; the world was created in 4004 B.C., complete with a past, and he has the fossil to prove it. Dean Wesley Smith's "Cutting Down Fred" offers the ancestral memory of oak trees to witness the dinosaurs; to share the memory, you have to raise your tree in a very particular way.

Many of the stories are cute, clever, and deft, and if they nonetheless often have a fairly familiar ring to them, that may simply be because:

1. Most of the authors are themselves familiar.
2. No one really seems to be pushing at the limits of either individual skill or the field as a whole.
3. Even if dinosaurs have never had an original anthology all their own, they have certainly had plenty of individual stories, novels, movies,

and TV shows.

On the other hand, dinosaurs are undeniably nifty critters, and the overall effect is quite entertaining.

Many people seem to think writers are unapproachable creatures who reside on lofty mountains and occasionally condescend to mingle with the masses on such occasions as book-signing parties and science fiction conventions. Some writers are precisely that unapproachable. Some are not.

That Piers Anthony is a member of the latter category is amply demonstrated by **Letters to Jenny**. Jenny was a twelve-year girl who had been run down by a drunk driver. Early in 1989, she was in a coma. Her mother, knowing how much she loved Piers Anthony's Xanth books, wrote to ask the author to write Jenny a letter and—maybe, just maybe, pretty please if you can—say he would put her in a story.

Anthony obliged, writing a careful, friendly letter which, when it was read to Jenny, evoked more response than anything else had managed to do. More letters followed, week by week, each one coaxing Jenny a little further along the path toward recovery, as well as covering Anthony's life, work, and thoughts about his work. Jenny left her hospital bed for a wheelchair. She attended a con. She became Jenny Elf.

Anthony's editor at TOR says, "We feel that these letters . . . have a universal appeal, and will be inspirational to any person undergoing the hardship of physical rehabilitation, or

long-term hospitalization.” They also demonstrate the Grand-Canyon immensity of Anthony’s heart and destroy forever any myth of his unapproachability.

Perhaps I should add that all writers—including book reviewers—receive letters from their readers. Some of those readers are very needy people, and it is really not all that rare for writers to respond by writing back with encouragement and support. Occasionally such exchanges of letters become long, epistolary relationships. Only rarely do they produce one or more books’ worth of material.

Whether you like Anthony’s Xanth fantasies or not, he is a warm and caring human being in a class by himself.

The other day I received from Roger E. Billings a copy of the first (1991) edition of his **The Hydrogen World View**, with a note saying, “Dear Reader, The paperback edition . . . which you have ordered is still on back order. To eliminate any further delay to you, we are enclosing a copy of the hardbound edition at no additional charge.” The book’s cover proclaims its author is *Dr. Billings*. The publisher is the American Academy of Science, whose address appears to be Billings’s own.

So, apparently the book is self-published and self-promoted. Since I hadn’t ordered the book, I suspect the paperback is what the computer industry refers to as “vaporware” and the letter was a sneaky ploy to get a reviewer to take the book seriously. Yet the book does seem seriously intended. Billings began experimenting

as a teenager with the use of hydrogen as a fuel for internal combustion engines. In time he converted cars to run on hydrogen, developed the use of metal hydrides for hydrogen storage, and founded corporations to develop and market hydrogen technology. His dream is a future when hydrogen is the universal fuel, as widely employed for transportation and home heating (among other uses) as oil is today. And he makes that dream seem quite as realistic as any of the dreams presented in this magazine’s fact articles. Certainly I—a biologist rather than a physicist or engineer—cannot fault his technical details.

So why did he have to self-publish? Billings’s style is rather lighter and breezier than academics prefer, and his topic is not one with a huge market panting to throw bucks at a commercial publisher. His content is well presented and convincing. If you have any interest in alternative energy media or the hydrogen economy, you will find this book interesting and useful. Go ahead. Write for a copy.

BOOKS ON DISK

It’s time for a couple of updates on disk-top publishing—now renamed “digital publishing” to avoid confusion.

Ted Husted (UserWare, 4 Falcon Lane East, Fairport, NY 14450-3312) just sent me the latest version (2a) of his DART display engine. It adds a number of new features, improves a few older ones, and remains one of the cleanest, most versatile, and most

efficient display programs available.

To my mind—and Husted's—clean efficiency is important, for a display program should not interfere with the reader's access to what is being read. Versatility is less important. Among those who don't agree with us is Rod Willmot, whose Orpheus I tutted over in September. When he saw the tuts, he wrote back to say that I had seen an older version (1.21), and here's the latest (1.53). When I test-drove it, I found the problems of 1.21 fixed and fixed well, though there did remain a few small problems, mostly along the lines of slow response and clunky feel. That is, it suffered in cleanness and efficiency. Versatility is quite grand—as anyone who remembers a little classical mythology might expect, Orpheus will even play music for you.

The twelfth issue of *The Electronic Publishing Forum* (\$9.32 from Serendipity Systems, P. O. Box 140, San Simeon, CA 93452) just arrived with a total of about a megabyte of material compressed onto a pair of 360K 5.25" MS-DOS disks. There's a large amount of news which I will sum up here by saying only that the cyberbooks idea seems to be picking up steam on a very wide basis.

A wide variety of display engines is now available. EPF12 includes a copy of REXXCOM's XL2000, used to display the Digital Publishing Association's "DPA News"; I found it unimpressive largely because it made hash

of its own attempt at graphics. Much better were the enclosed samples of two very compact, clean, and efficient programs, `TEXTBOOK.EXE` for displaying text alone and `GRFBOOK.EXE` for displaying text plus graphics.

EPF12 also includes a description of `DC GOLD`, a 1.44 megabyte disk containing fourteen of the best shareware digital publishing display engines, available from Ted Husted (UserWare, address above) for a mere \$12. This is a bargain when you consider that the disk's 1.44 megabytes will decompress to several times that amount of software. It's even a bargain when you consider that shareware means that if you like something and wish to use it, you still have to pay the original source.

Vincent Pauli's **Resurrection on C Five** (available for \$5 from Northern Sky Publishing, Rt. 2, Box 192, Clearbrook, MN 56634) is a diskbook (a novel on disk) with an intriguing premise: Future archeologists open up an old cinderblock building and find within it a functioning cryopreservation system containing a human being. Revival occurs in space, on the C Five habitat, and the story tracks the encounter of old world and new.

The story's not bad for amateur work, but it's still not terribly readable. The prose is vague, wordy, and stiff, and the author does not show enough skill at bringing his story to life. ■

BRASS TACKS

Dear Dr. Schmidt:

I am a science fiction fan. I am also the youngest of five children in a very literate family, known, when I first went to school, as "the boy who swallowed the dictionary."

It is rare that I come across a word in my daily life or reading that I have to go to the dictionary.

I am currently reading a long, overly-involved story by Orson Scott Card in your Jan. '91 edition. I haven't finished the story yet, so don't know whether or not it will come to a conclusion that satisfies me. Title "Gloriously Bright."

But in the process I have come across two words whose meanings I do not know. They are "ansible" and "philotic."

So I went to the dictionary, *The American Heritage Dictionary of The English Language* published by the Houghton, Mifflin Co., in 1969.

I could not find either word listed.

What kind of editing do you do? Do you customarily let words go by that you cannot find in the dictionary? Can you give me some kind of an explanation?

NOAH LICHTERMAN

Thanks for your letter of April 6. Your question surprises me a little, if you've been a science fiction fan very

long, because science fiction frequently contains words that can't be found in dictionaries. It has to, because it's usually set in times and places containing things for which we have had no occasion to coin words. Sometimes these words are explicitly defined within the story; sometimes their meanings can be deduced from context; sometimes their exact meaning is unimportant and it's only necessary that the reader recognize that they're future or alien terms for something we don't have, such as an exotic food or a new scientific principle.

Sometimes a word is introduced in one story and subsequently passes into common use in others, by other writers, and eventually into dictionaries. "Ansible" is one of those; Ursula LeGuin first used it to mean a type of instantaneous communicator, and many writers now use it in the same way. I suspect you'll even find it in some late-model dictionaries—but certainly not a 1969, since it first appeared in 1974. (But then, that's true of lots of words in everyday use, not just science fiction. Time for a new dictionary!)

Dear Dr. Schmidt,

Kudos for publishing "White

Analog Science Fiction and Fact

Room" (Stephen L. Burns, May '93). As a caring physician incarcerated in Tennessee's largest prison, I can vouch for the realism of inmate Thomas's entry into prison. The need for rehabilitation is addressed and met with a solution that would be feasible if our prison systems were motivated toward rehabilitation, and the human use restrictions put on the medical profession could be set aside. Unfortunately, Tennessee inmates are blatantly told they are "not in prison for rehabilitation but for warehousing." Prison infirmaries see no need to treat emotional problems with anything except overmedication. I'll be glad to answer anyone interested in improving our nation's prisons.

In response to Stephen K. Halter's request of the USPS to honor our beloved Dr. Asimov on a stamp, he's by now been informed that Dr. Asimov hasn't been dead the required ten years. Hope remains, though, in that a pictorial postmark honoring SF and Dr. Asimov could be used at a SF convention by following the enclosed directions. In addition, some countries have no prohibition on honoring even living individuals on their stamps. Countries such as Grenada-Grenadines, Dominica, St. Vincent and others can be contacted. One who deals in stamps issued by these island nations, such as the Inter-Governmental Philatelic Corp., 460 West 34th St., New York, NY 10001, could probably supply the address of the agency to contact in a given country, as well as advising on which nation would be most likely to print a stamp or series of stamps honoring Dr. Asi-

mov. I don't know Russia's rules on honoring individuals on its stamps, but this might be worth pursuing in light of Dr. Asimov's Russian beginnings and Russia's interest in furthering favorable ties with the West.

I'm interested in prison philately as a way of productive use of time and of self-rehabilitation. I would welcome any letters, as well as any donations of used albums or stamps for use in forming jail and prison stamp clubs in East Tennessee.

KEN EMERSON, M.D.

2645 S. Wilcox Drive
Kingsport, TN 37660

Dear Stanley Schmidt,

The May '93 issue was my first, but I was immediately impressed by Stephen L. Burns's short story, "White Room." As an ex-convict with five years in federal prison behind me, much of it in solitary confinement, I can only marvel at the author's depth of understanding. Very little SF has seriously examined penology, but Burns has zeroed in on the lack of empathy which makes victimization possible, has appreciated the many hidden effects of victimization on the survivor, and has understood the psychological effects of solitary (and the impossibility of maintaining it indefinitely). I wish I could place a copy of his story on the desk of every "corrections" administrator and legislator. The sad fact is that our current systems of incarceration makes prisoners more antisocial, not less, while teaching them more sophisticated modes of crime. Far from teaching empathy, jails and prisons today

teach first-time prisoners that whatever empathy is in them when they arrive (and few are completely dehumanized at that point) is a weakness to be stamped out quickly, lest it become a dangerous vulnerability in the ceaseless internal power struggle among those who have otherwise been rendered powerless. The few cases of rehabilitation in these hate factories occur in spite of the "correctional" system, not because of it.

My only question to the author is, what would he do with those imprisoned for victimless crimes?

STEPHEN DONALDSON

President, Stop Prison Rape
3147 Broadway #12A
New York, NY 10027

Dear Dr. Schmidt

Thank you for sharing your experience with TravTek (May '93 editorial). This is a splendid case of reality catching up with science fiction. And it does bring up the subject of the "car of the future," one aspect of which I feel has been ignored. Recently, the press has had coverage of plans by the state government of California to mandate the use of zero-emissions vehicles (ZEV) in the coming decade. But almost all of the vehicles discussed are battery-powered electric cars. There are other approaches that just don't seem to get much attention, and I am enclosing a copy of a magazine article that features just such an innovative approach, namely the E-TRAN vehicle propulsion system. Basically, this is a system for electrically powering vehicles externally, as opposed to using

a self-contained energy storage system. It uses a conducting rail imbedded in the pavement in the center of each lane of traffic, and eliminates the drawbacks of the "third rail" used by electric trains (namely, needing a "ground" rail for return current, plus a significant safety hazard from the continuously energized rail) by segmenting the rail and energizing the segment only when a vehicle is over it by using a proximity sensor. The vehicle has two pickup contacts, one in the front and one in the back, and the polarity (or phase, for AC) of the current is switched between the front and back contacts to complete the circuit.

I am most excited about the possibilities E-TRAN opens up for the future. It has been possible for many years to build an automatic steering system for an automobile, but it requires a special wire buried in the pavement (many automated warehouses use unmanned trucks which operate on this principle). Well, the E-TRAN rail is the equivalent of a buried wire! With the addition of a collision avoidance (automatic braking) sensor (also a demonstrated technology) and a navigation system (such as TravTek), a completely "hands-off" automobile is practical in the near future with benefits in convenience, economy, safety and environmental protection. I don't really expect to see such a vehicle in the near future mainly due to political reasons (after all, this just makes too much sense).

AVERY DAVIS

Marietta, GA

* * *

Dear Stan:

Your May, '93, editorial brought back memories: When I was dabbling with aviation back in 1960, we were required to spend a couple of hours in Cessna 172s (in addition to training in *real* airplanes—J-3 Cubs) to gain a rudimentary grasp of how to use radios and survive “flying blind” briefly, should circumstances (and, more realistically, our own stupidity) conspire to require it.

At that time it occurred to me that IFR flying would be less stressful if we had a small CRT screen in the panel which displayed a moving chart of the area in which you were flying, with you-are-here-and-pointed-this-way airplane in the middle of it: the “moving-map” concept before the term had been coined.

My notion at that time was to transmit local chart images from broadcast facilities similar to the VOR system (perhaps combined with it), and have the onboard receiver employ existing RDF technology to triangulate your position from VOR, commercial radio, and/or television signals (today we have LORAN as well), and paint the location and orientation on the screen. It seemed an elegantly simple, even obvious, solution. With 30 years' hindsight, it still does.

However, the mini- and microcomputer revolution upgraded the concept to one based on onboard computers with charts hardwired in via ROM cartridges. In addition to “merely” triangulating broadcast signals and painting your current location and orientation onscreen, the onboard computer (with data links to

the fuel-flow meter, radar altimeter, airspeedometer, magnetic compass, etc.) would furnish realtime updates of fuel-management data, ground-speed, wind direction and speed, and ETA, as well as (once a particular plane's power-off sink-rate was plugged in) highlighting all airfields within likely gliding range in an emergency.

The value of an onboard system like this to the typical low-time, limited-proficiency private pilot can't be overstated. And it wouldn't even cost much.

But there's more—if the FAA could be persuaded to get on the bandwagon: During IFR conditions, the onboard computer could communicate with air-traffic-control's mainframes in high-speed, data-dense bursts, maximizing Big Brother's communications capacity, while letting BB know *exactly* where you are, *exactly* how high, *exactly* how fast you're going, *exactly* what your fuel situation is, etc., which would permit much more efficient airport traffic management as well as control generally.

Contrast this with the FAA's current high-priced, routinely overloaded, ineffective system, and the still-higher-tech, much-higher-priced logjam-prescription they've slated for later this decade.

The “modern” FAA's technology still hasn't matched the results my 1960 suggestion would have produced—never mind my current microcomputer-based concept. They're still trying to do it the hard way; still ignoring relatively simple existing

technology in favor of multijillion-dollar satellite links, and Big Brother's centralized, next-next-next-generation-superconducting-Cray-based, obsessive micromanagement.

From your editorial of 5/93, it appears the road-based transportation industry is determined to make the same mistake. An onboard micro-computer which triangulated its position in real time from commercial broadcast signals would *not* get lost in a parking lot. It could also determine from your direction, or a previously filed "driveplan," which local traffic-condition or hazard-warning broadcasts were applicable to you, and pass them along.

Some things never change: Governmental and/or big-business committees, when asked to design mice, still wind up manufacturing elephants.

In *Footfall*, Larry Niven and Jerry Pournelle envisioned a U. S. administration wise enough to include SF writers in their planetary-defense think-tank. You could tell it was fiction. . . .

DAVID R. PALMER

Dear Mr. Schmidt,

I have just finished the novelette "Sunshine, Genius, and Rust" by Jeffery D. Kooistra (May '93). I was left with a gnawing feeling that his geniuses have overlooked something about the aliens in the story. Even his military experts seem to have overlooked the possibility that the human race is playing an interstellar game of chess in which the opposing side has begun with a gambit.

In chess terminology, a gambit is

the voluntary loss of one or more pawns in the expectation of gaining a substantial, and decisive, lead in development and offense. Quite often, the defender is forced to accept the gambited pawn. At the close of the story, the human race has gained a working model of a weapon, an alien body, and a working star drive. These are important gains, but they were too easily won. The young researcher in the story, Richard Michaels, said the alien search pattern did not make sense. The nonsensical pattern made sense if the objective was to permit the capture of the weapon and the body.

Why would the aliens permit these captures? If I were the alien commander, I would let the humans capture an obsolete weapon and an obsolete android with the expectation that the humans would change their defenses to defend against obsolescence. When I, as the alien commander, began my true attack, I would expect to sweep the humans from space with one mighty blow.

Have I found the plot line for the sequel to this story, and if so, will the humans be able to recognize the gambit in time?

THOMAS B. KNOEDLER

Springfield, IL

The author replies. . . .

Dear Stan,

Mr. Knoedler suggests a sneaky plot on the part of the Phinons which I found delightful. Perhaps in a future story a Colonel Knoedler may take a cameo appearance just to voice this concern. I agree that the humans make a few gains relatively easily

Analog Science Fiction and Fact

(and there's a good reason for why that has to be, which future stories will reveal), but why would an alien commander give the enemy a working star drive, obsolete or not, when it didn't have one at all to begin with? In an alternate universe, would the Europeans have given the Indians broadswords and suits of armor just so they could mow them down later with guns?

Still, I like the chess metaphor, but let's push it a little bit. The situation with the Phinons is like this: You are forced to begin a correspondence chess match somewhere in the middle when you receive a letter telling you the positions of all your pieces but none of the opponents. It's his move, and you receive the note g4. You now know he has a pawn, and where it is. You are able to reply Nxg4. His reply is Rxg4, costing you a knight, but you don't even know where the rook came from, and so on.

The humans do not know the nature of the opponent, nor what pieces he has, nor why he picked now to start the game, *nor whether he even knows the rules*. The move with the rook may have been illegal. How would you know?

In short, Mr. Knoedler has not found the plot line for a sequel, even though there is another story soon to see print and others on the way. But his plot line looks interesting—maybe he should write a story around it. I'd like to see it.

JEFFERY D. KOOISTRA

Dear Mr. Schmidt,

As a twenty-year-member of the US Air Force and a veteran of Desert

Shield/Storm I was getting thoroughly disgusted by the negative portrayal of the military in May's story "Sunshine, Genius, and Rust"; until I reached the last page.

The author, Jeffrey Kooistra, turned the tables as sweetly as I've ever seen. And he said something that a lot of us, with our cynical, mouthy exteriors feel deep down in our souls—something that causes a person to put up with all the political malarkey and stay in the military as long as we can—"... there was something more important he had to do."

I hope to see more of Mr. Kooistra's work in *Analogue*.

JOHN FORBES

5387 Leprechaun Lane
Salt Lake City, UT 84118

P.S. I enjoyed the story so much I wrote this letter without reading the rest of the issue!

The author replies...

Insofar as my views on the military can be categorized, I guess saying I am "very pro military" covers it best. However, Sammi had a lot to learn in that story, and though I love her dearly, she was a little too soft-headed about military matters for most of the tale.

But what I really wanted to say was this—I read your letter not two minutes after walking in the door upon my return from the Nebula Awards where Stan presented me with the Anlab Award for best short story of the year. Your letter gave me a feeling every bit as good as the one that winning the award did.

JEFFERY D. KOOISTRA ■

Classified Marketplace

AN MID-DECEMBER '93

ANALOG/ASIMOV'S combination CLASSIFIED AD rate is \$4.80 per word—payable in advance—(\$72.00 minimum). Capitalized words 60¢ per word additional. To be included in the next issue please send order and remittance to Judy Dorman, DELL MAGAZINES, 1540 Broadway, New York, N.Y. 10168-0035.

ACUPRESSURE & CHI POWER

**Master the Power:**
© 1993
For most it works the first day!

Move objects with Scientific Premium Company • USA Chi Power Plus™ without touching them ★ Extinguish a candle flame with your eyes only ★ For speed faster than a cat, try this test ★ Attract people, fish, birds, or animals, with Chi Power ★ Or repel them ★ Quickly disable your enemy with SPC • USA Pressure Points™ ★ Erase pain completely with Pressure Points. 90-day trial and moneyback guaranteed. Lifetime knowledge. CALL 800 334-7353 fast C.O.D., \$84.90. OR MAIL \$80.90 to: SPC • USA, Dept 54, P.O. Drawer 10, Middletown OH 45042.

ART AND DESIGN

ART PRINTS AND POSTERS BY KEITH PARKINSON. For information on prints by Parkinson and other artists, contact SHADOW GRAPHICS, P.O. Box 199, Lititz, PA 17543.

BOOKS & PERIODICALS

100,000 science fiction and mystery paperbacks, magazines, hardcovers. Free catalogs! Pandora's, Box Z-54, Neche, ND 58265.

FREE CATALOGS of science fiction pulps, digests, paperbacks, hardcovers, Collections also purchased. Bowman, Box 167, Carmel, IN 46032.

BOOKS & PERIODICALS—Cont'd

AMBERZINE! Authorized journal of Roger Zelazny's Amber. Write: Phage Press Aaz., Box 519, Detroit, MI 48231-0519.

In The Future . . .

**YOUR
Classified/Display**

**AD
CAN BE
PLACED HERE**

For details
SF CLASSIFIED
1540 Broadway
New York, N.Y. 10036
(212) 782-8549

CATALOGS AND DIRECTORIES

BEST selection of DRAGONS AVAILABLE! Sculptures, T-Shirts, Stationery, Rubber Stamps and Much More. Full color catalog \$2.00. Dancing Dragon Designs, Dept. AN, 5670 West End Rd #4, Arcata, CA 95521.

PSYCHIC HELMET - Time travel - Teleportation - Levitation - UFO'S - Aliens - HUGE CATALOGUE \$3.50 Research Society 255 N. El. Cielo #B565B, Palm Springs, CA 92262.

Classified Continued

AN MID-DECEMBER '93

COLLECTIBLES

COLLECTIBLE cards—Star Trek, Jurassic Park, X-Men, More. \$1-5 samples and prices, \$5-30 samples, 1 hologram & prices. Nimbus 5532 Woodruff Avenue #203, Lakewood, CA 90713

PERSONAL

BEAUTIFUL BRITISH LADIES & ELIGIBLE BRITISH GENTLEMEN seek friendship, romance & marriage with American ladies & gentlemen! All ages! Free details: ENGLISH ROSE INTRODUCTIONS, (Dept. 123), Suite 2, 24, Cecil Square, Margate, Kent, CT9 1BA, ENGLAND. TEL: 01144-843-290735.

PERSONAL—Cont'd

GAY CONTACTS! Write: MMM Inc. PO Box P(A), Conway, New Hampshire, 03818.

TAPES & CASSETTES

OLDTIME RADIO PROGRAMS. Great Science Fiction! Also, mysteries, comedies, westerns. Free catalogue. Carl D. Froelich, Heritage Farm, New Freedom, Pennsylvania 17349.

SCI-FI audio adventures, Asimov to Zelazny. Free catalog. ATC Books, Box 690791, Houston, TX 77269-0791.

For Greater Savings...Results...and Profits...

PLACE YOUR AD IN ONE OF OUR SPECIAL COMBINATIONS:

Combo #1, Combo #2, Combo #3

Each combination is designed to give your ad the largest audience available.

Each combination offers you a Special Discount Rate.

For further information write to Judy Dorman

Dell Magazines, 1540 Broadway, New York, NY 10036.

**YOU'LL MAKE
MONEY**

**SAVE MONEY TOO
BY READING AND ANSWERING
THESE CLASSIFIED ADS**

UPCOMING EVENTS

Anthony Lewis

26-28 November

LOSCON 20 (Los Angeles area SF conference) at Airport Hilton, Burbank, Calif. Guest of Honor: Roger Zelazny; Fan Guest of Honor: Paul Turner. Registration: \$25. Info: Los Angeles Science Fantasy Society, Inc., 11513 Burbank Blvd, North Hollywood CA 91601.

26-28 November

Darkover Grand Council Meeting XIV (emphasizing the work of Marion Zimmer Bradley and similar writers) at Timonium, Md. Guest of Honor: Elizabeth Moon. Registration: \$30. Info: Armida Council, Box 7203, Silver Spring MD 20907. (202) 737-4609 (before 11.15 pm ET)

24-25 December

POLECON '93 (High Arctic SF conference) at the Workshop, Ninety North. Guest of Honor: Kris Kringler; Fan Guest of Honor: Frosty; Tm: Bob Tucker. Registration limited.

14-16 January 1994

CHATTACON 19 (Tennessee SF conference) at Chattanooga, Tenn. Guests of Honor: Terry Prachett, Dean Ing. Registration: \$18 until 15 November, \$25 until 1 January. Info: Box 23908, Chattanooga TN 37422-3908.

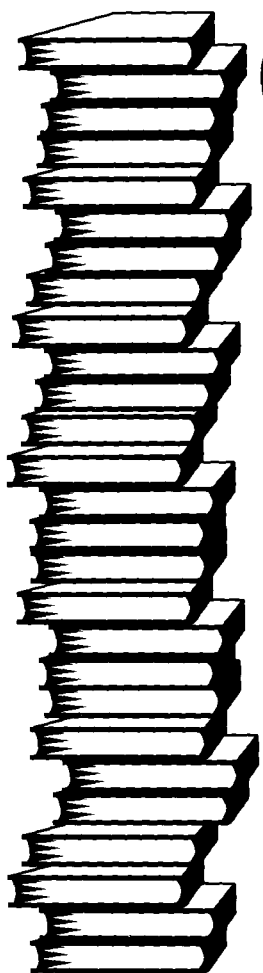
18-20 February 1994

BOSKONE XXXI (New England SF conference) at the Sheraton Tara, Framingham, Mass. Guests of Honor: Emma Bull & Will Shetterly; Official Artist: Nicholas Jainschigg; Special Guests: Patrick & Teresa Nielsen Hayden. Registration: \$30 until 15 January, more at the door. Info: Post Office Box 809, Framingham MA 01701-0203.

1-5 September 1994

CONADIAN (52nd World Science Fiction Convention) at Convention Centre, Winnipeg, Manitoba. Guest of Honour: Anne McCaffrey; Artist Guest of Honour: George Barr; Fan Guest of Honour: Robert Runté; TM: Barry Longyear. Registration: \$85 (C\$95) adult, \$30 (C\$35) child until 30 September 1993, Supporting: \$25 (C\$30). This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: Conadian, Box 2430, Winnipeg MB R3C 4A7 Canada or Box 7111, Fargo ND 58109. (204) 942-9494; FAX (204) 942-3427.

Anthology Sale!



Reward yourself with hours of enjoyment with our nine science fiction anthologies. Taken from Asimov's Science Fiction and Analog Science Fiction & Fact magazines, these classic stories will have you entering new dimensions.

Send check or money order for \$20.95 to:

**Dell Magazines
P.O. Box 40
Vernon, NJ 07462**

Be sure to include your name and address.

Please allow 6-8 weeks for delivery. For shipping and handling outside U.S.: Canadian orders add \$4.00, Foreign orders add \$6.00.

M6AF-9

MAIL ORDER MALL

CALL TOLL FREE 1-800-722-9999

▼ THE MAGICAL SPARE BED

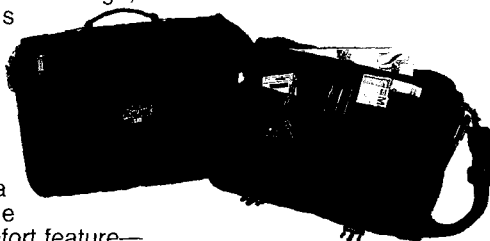
It's almost like pulling an extra bed out of a hat. Unlike most spare beds that gobble up storage space and are unwieldy to move, this one rolls down to fit a 36"-long, 3"-diameter canvas case, to stash in a closet corner, car trunk, camper, anywhere. Yet it unrolls in minutes to a full-size 27"x73" bed that will even accommodate 6-footers. The secret's in the inventive construction: a cotton canvas sling is supported on laminated steel legs for cushioning and stability on rough ground. Toss the carrying strap over your shoulder and go—camping, beach, poolside, the 10" legs keep it off damp ground and sand. This bed is indispensable at home, country home,



dorm—even for kids in motel rooms. A superb value at \$61.98 (\$12.25) #A1931.

▼ EVERYTHING BAG—BY LOCOMOTOR

People on the go always have so much to carry around, but the expandable portfolio bag by Locomotor makes it a snap to keep everything in place. This roomy (17"x14") bag is constructed of tough, water-resistant black canvas material and features eleven spacious extra pockets (2 with zippers) and 4 slots for pens. Plus, a unique zipper design enables the bag's main compartment to expand to more than double its normal width—to a full seven inches. Adjustable wide shoulder strap provides a real comfort feature—or carry the bag by the durable handle. This black Locomotor Bag lets you keep it all together whenever you are on the go. #A2057—\$26.98 (\$5.75).



TO ORDER: Send check with item number for total amounts, plus shipping & handling shown in () payable to **MAIL ORDER MALL DEPT 133 AN**, P.O. Box 3006, Lakewood, N.J. 08701, or call TOLL FREE 1-800-722-9999. NJ residents add 7% sales tax. We honor MasterCard, Visa, and American Express. Sorry, no Canadian, foreign, or C.O.D. orders. **30 day money back guarantee for exchange or refund.**